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Maimin et al.

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(54) **TRUCK BOX COVER WITH LOCK DOWN ELEMENTS**

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(51) **Int. Cl.**
B60J 7/14 (2006.01)
B60J 7/19 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **B60J 7/085** (2013.01); **B60J 7/102** (2013.01); **B60J 7/1856** (2013.01); **B60P 7/02** (2013.01); **B60P 7/04** (2013.01)

(58) **Field of Classification Search**
CPC . B60J 7/185; B60J 7/085; B60J 7/1856; B60J 7/198; B60J 7/19; B60P 7/04; B60P 7/02
(Continued)

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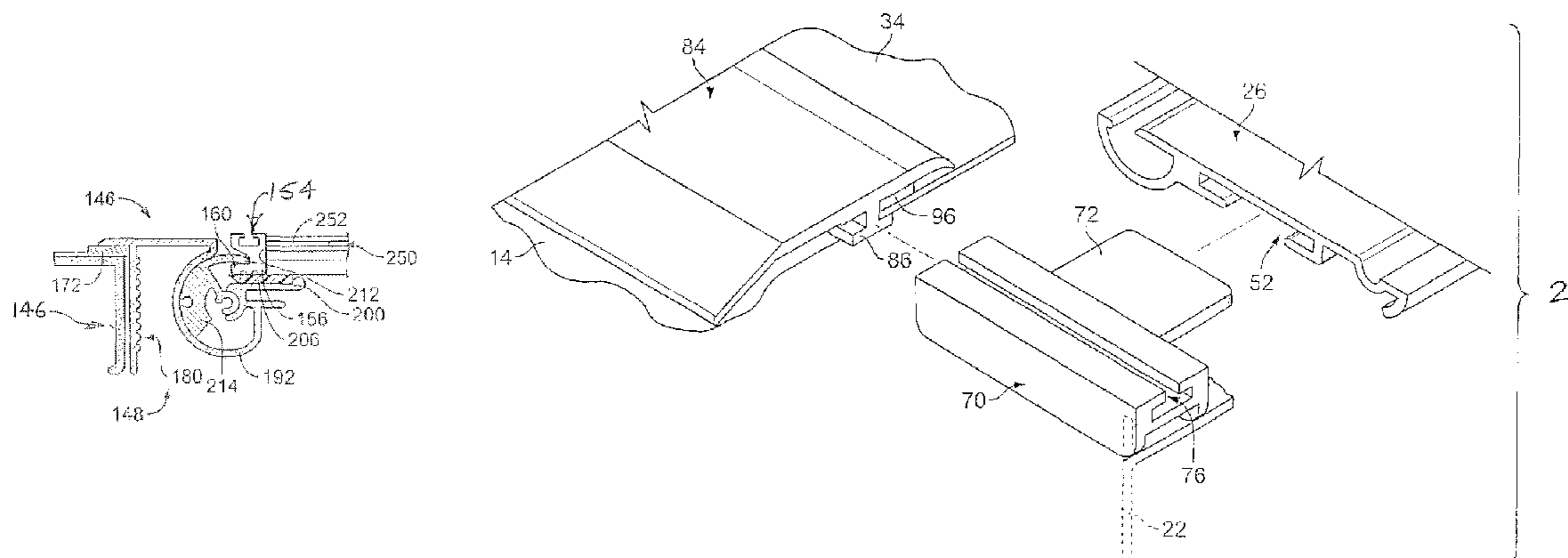
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(57) **ABSTRACT**

A plurality of pivotably connected slats can be movable between a closed position wherein the slats cover the vehicle box, and an open position. At least one slat can include a first and second end fittings having first and second fixed locking elements, respectively. Each of first and second side rails can include a movable locking element movable between a locked position in which the movable locking elements in the closed position engage an adjacent one of the fixed locking elements to restrict movement of the at least one slat away from each side rail, and an unlocked position in which the movable locking element is disengaged from the adjacent one of the fixed locking elements allowing movement of the at least one slat toward the open position.

24 Claims, 18 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/011,523, filed on Aug. 27, 2013, now Pat. No. 8,939,494, which is a continuation of application No. 13/653,766, filed on Oct. 17, 2012, now Pat. No. 8,544,934.

- (60) Provisional application No. 61/621,921, filed on Apr. 9, 2012, provisional application No. 61/602,280, filed on Feb. 23, 2012, provisional application No. 61/553,885, filed on Oct. 31, 2011, provisional application No. 61/553,828, filed on Oct. 31, 2011, provisional application No. 61/553,814, filed on Oct. 31, 2011.

- (51) **Int. Cl.**
B60J 7/08 (2006.01)
B60P 7/02 (2006.01)
B60J 7/10 (2006.01)
B60J 7/185 (2006.01)
B60P 7/04 (2006.01)

- (58) **Field of Classification Search**
 USPC 296/100.09, 100.04, 100.07, 98;
 292/DIG. 14, DIG. 43, DIG. 44
 See application file for complete search history.

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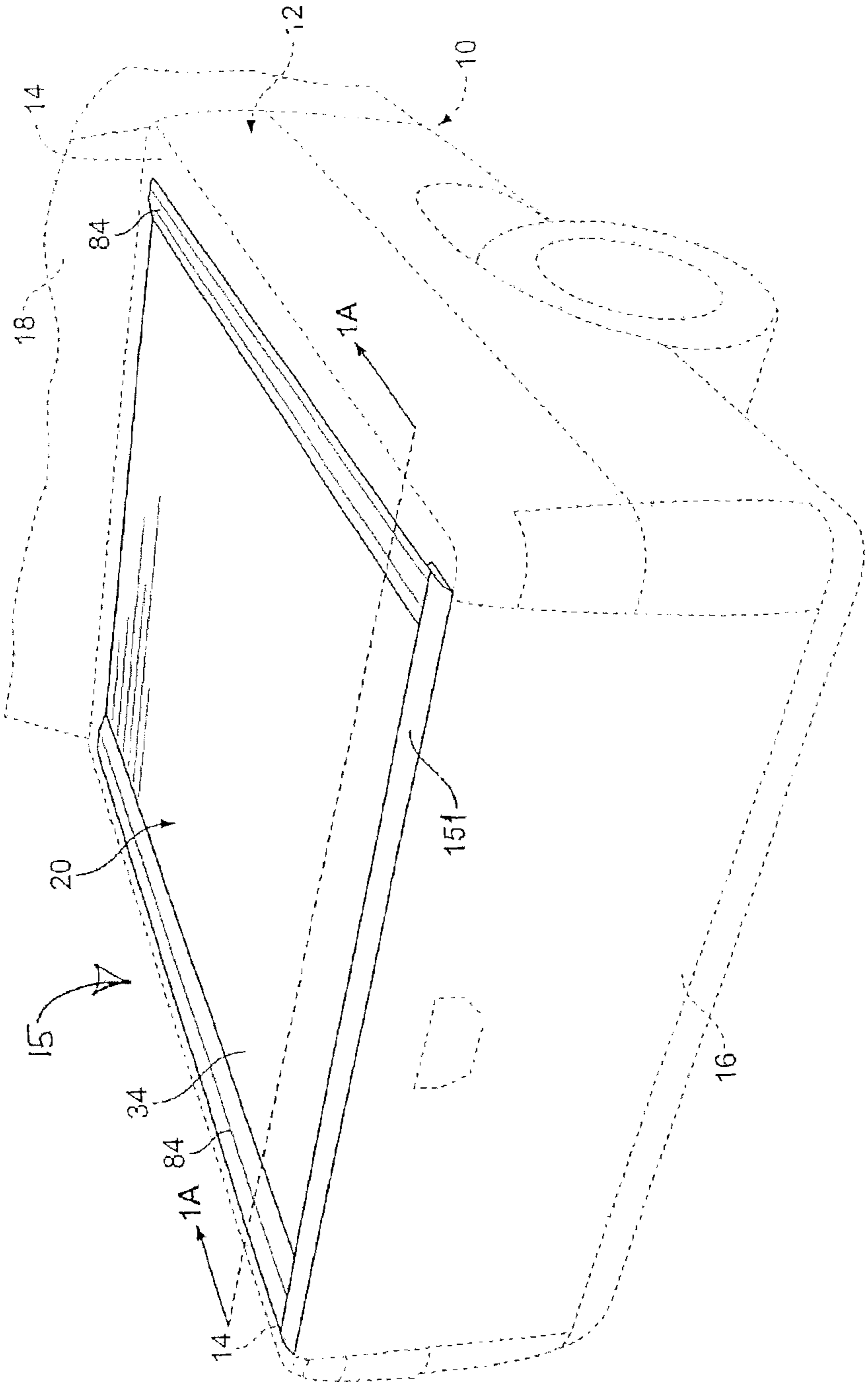


FIG. 1

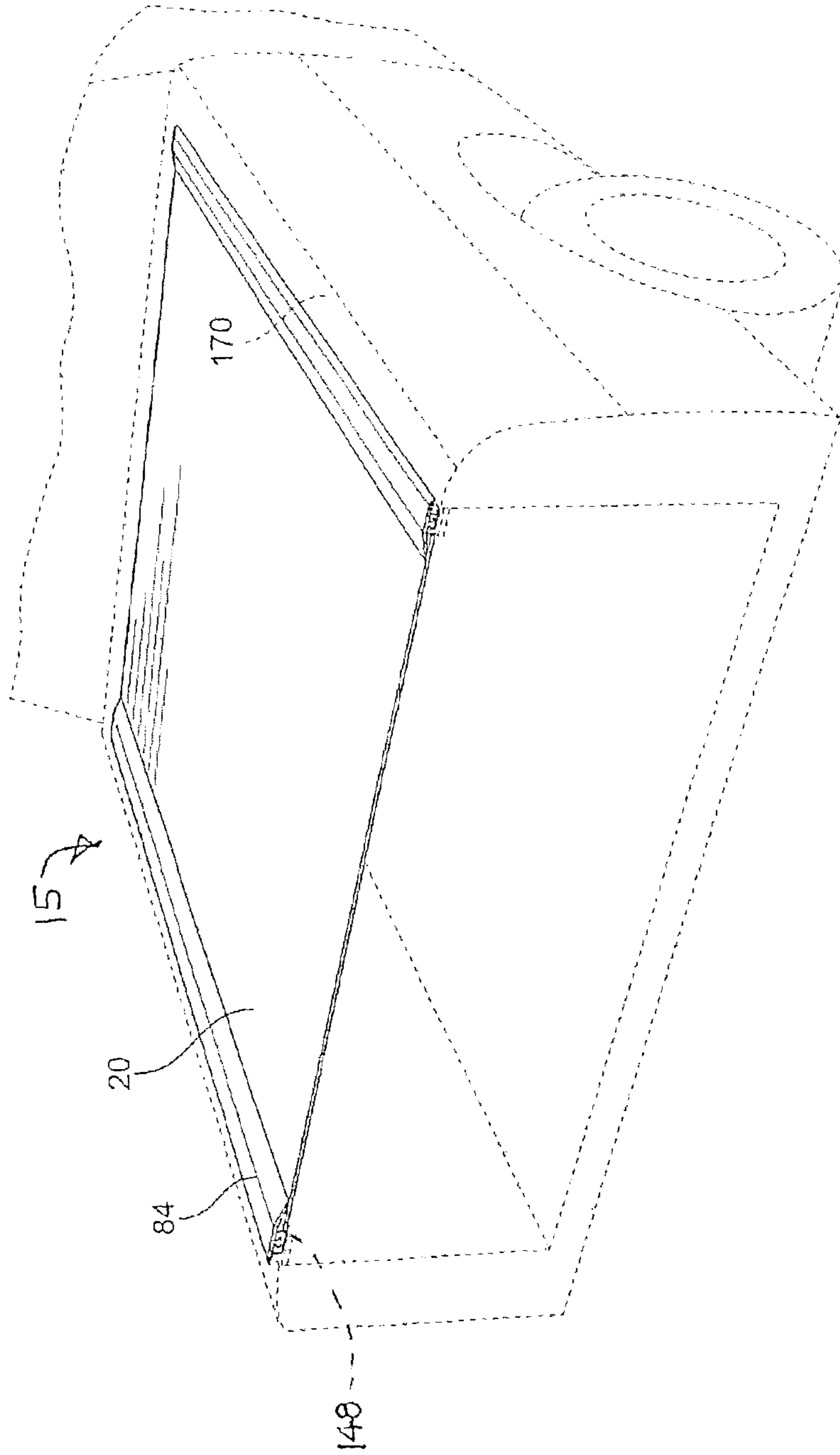


FIG. 1A

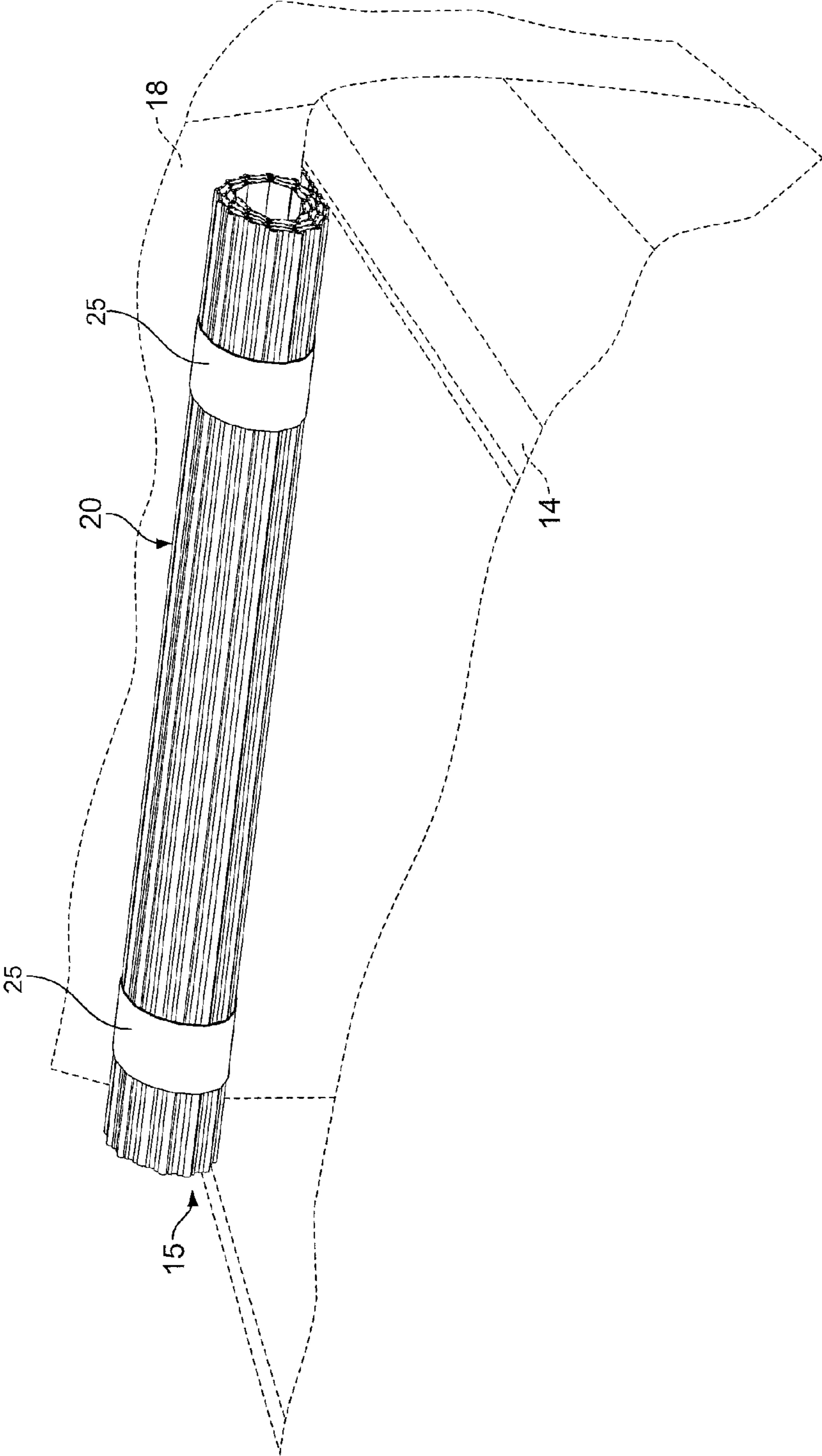
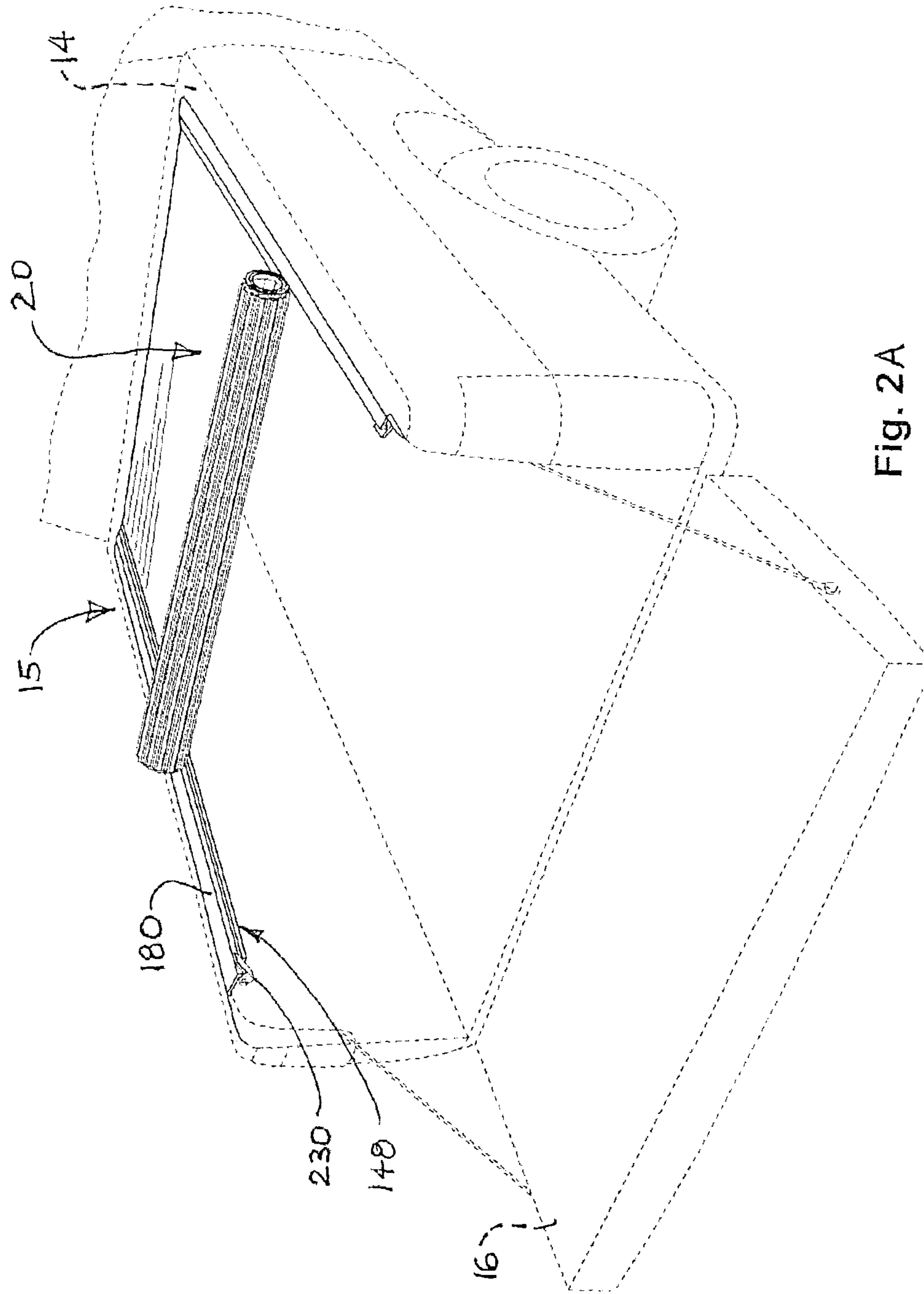


FIG. 2



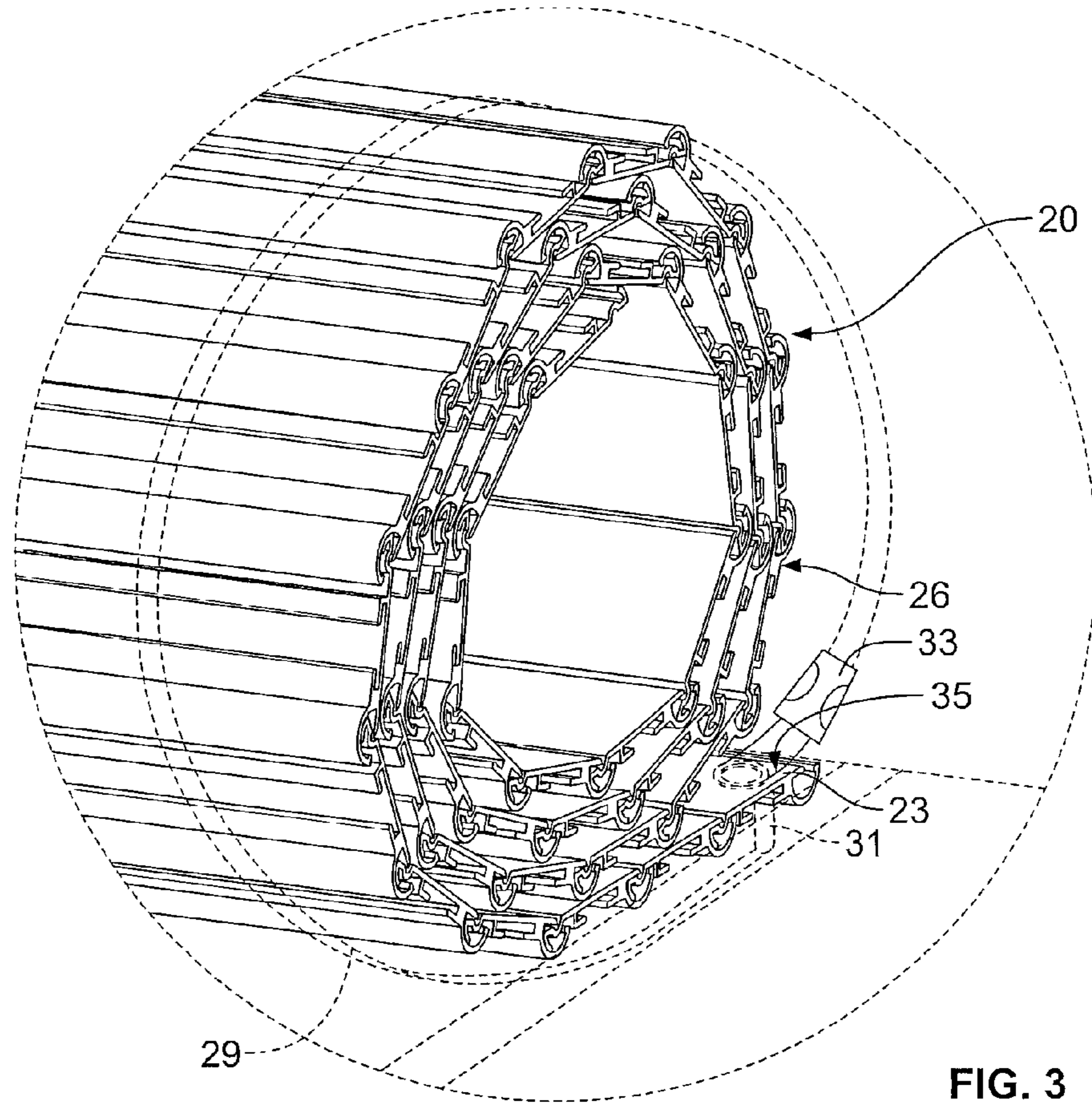


FIG. 3

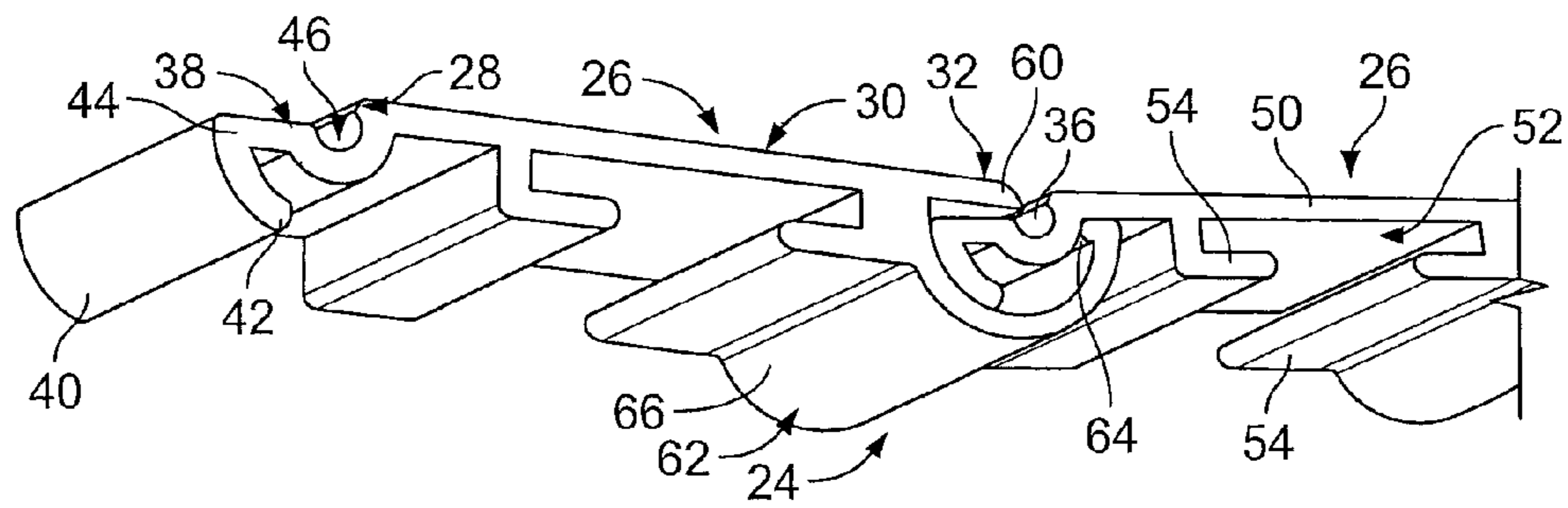


FIG. 4

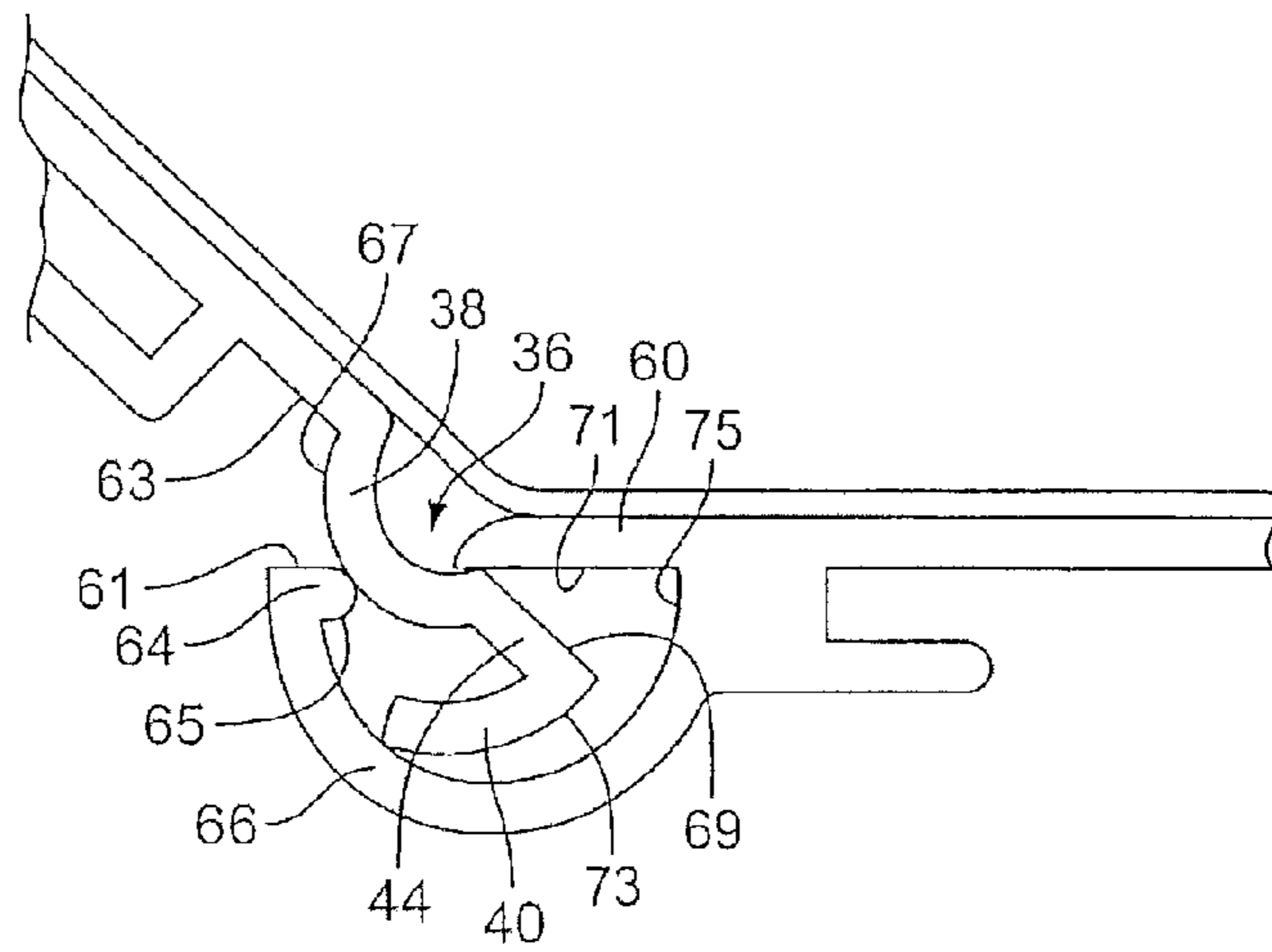


FIG. 4A

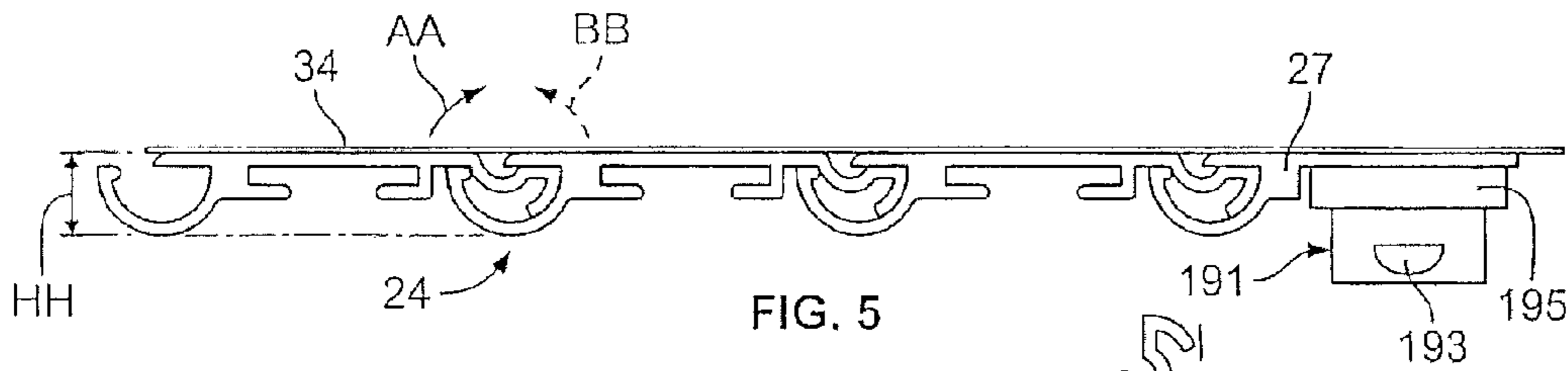


FIG. 5

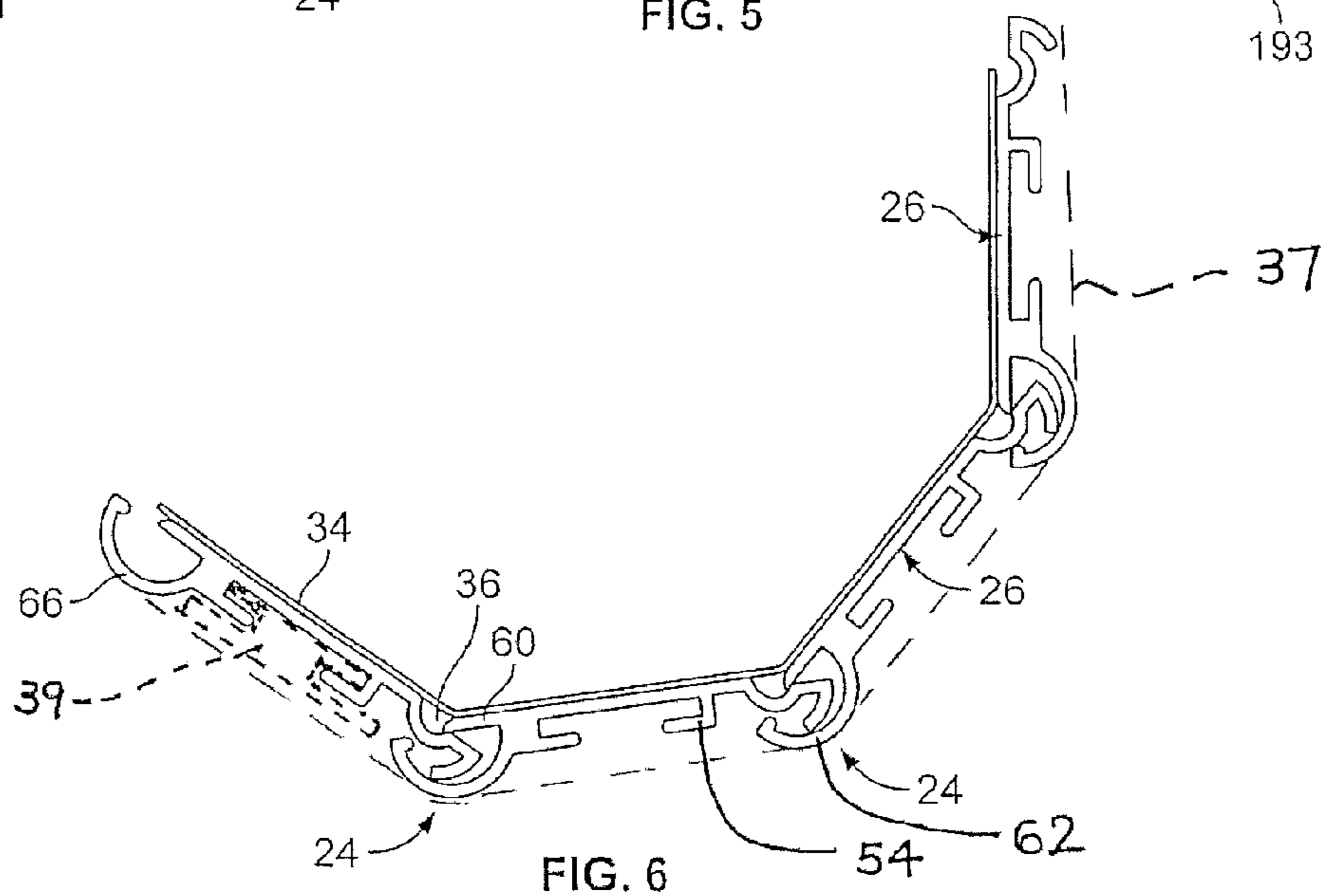


FIG. 6

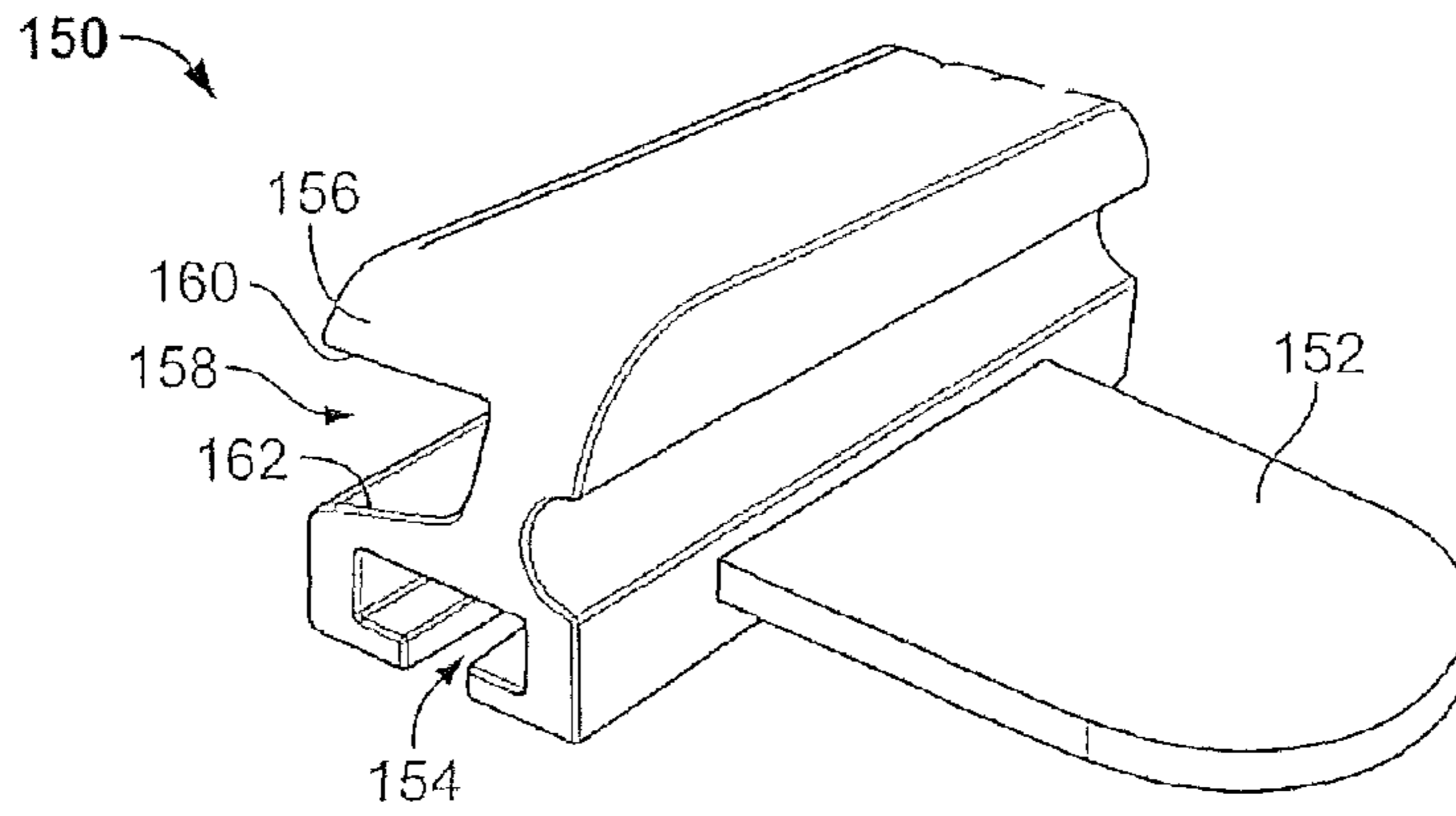


Fig. 7

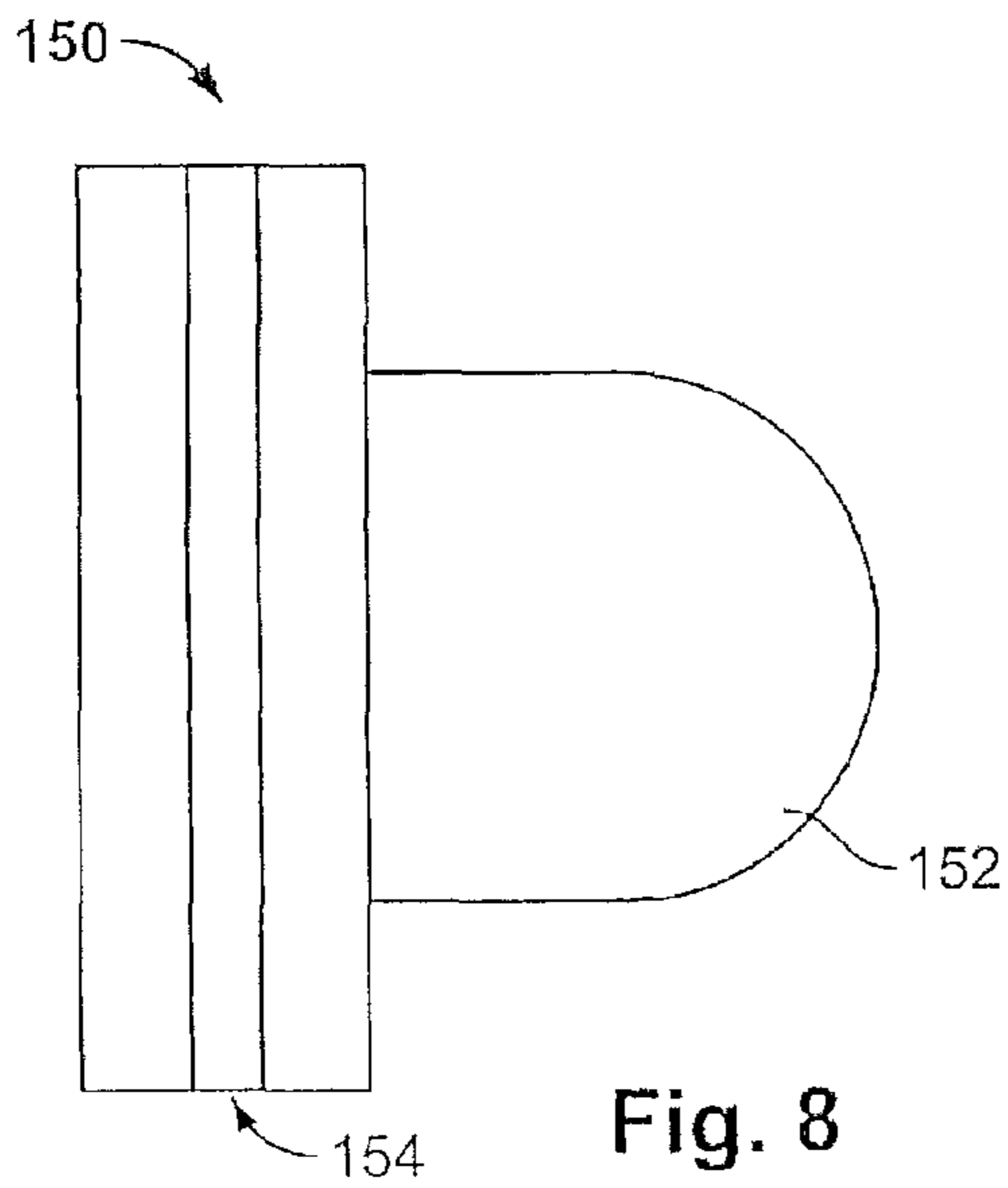


Fig. 8

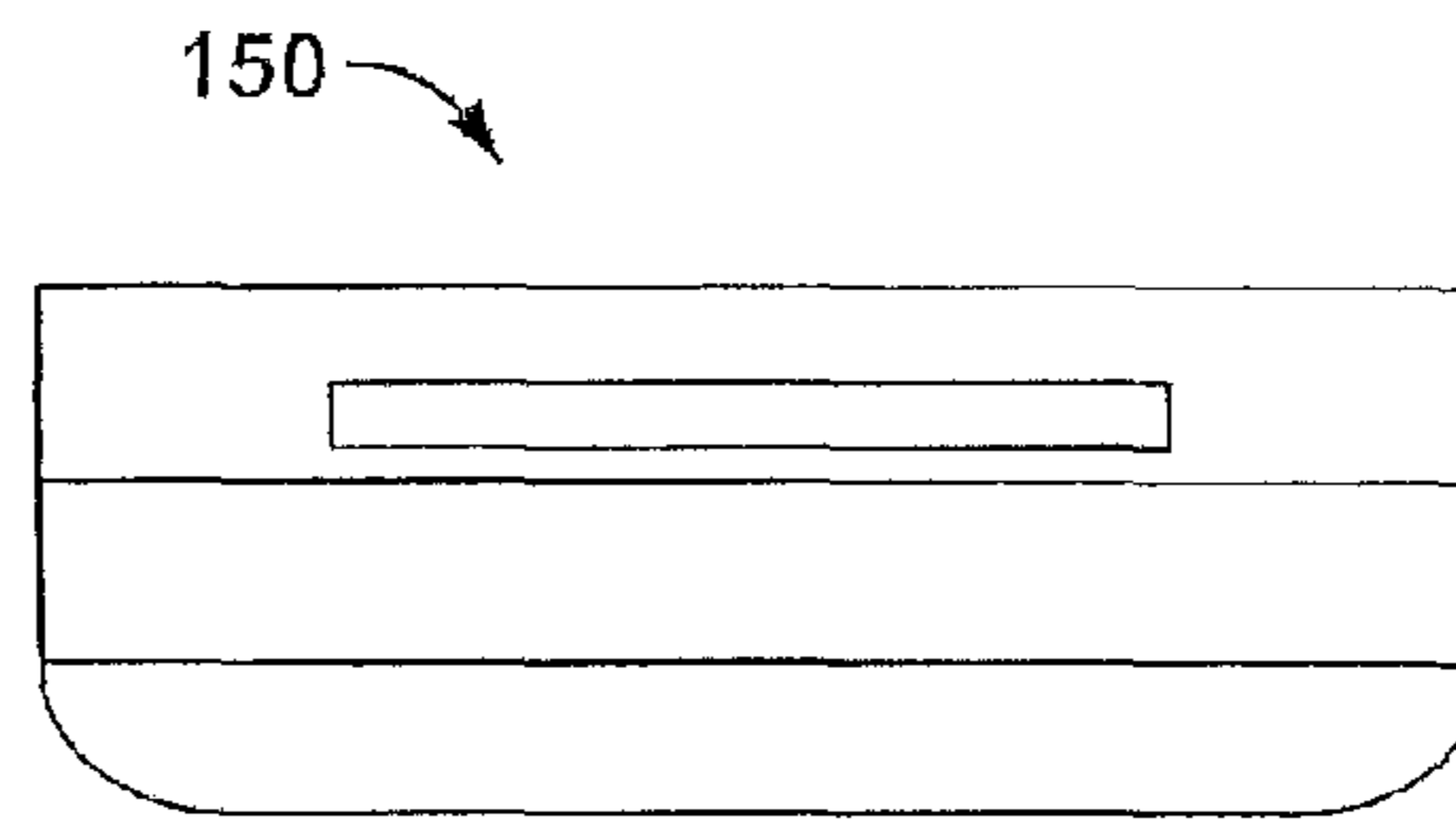


Fig. 9

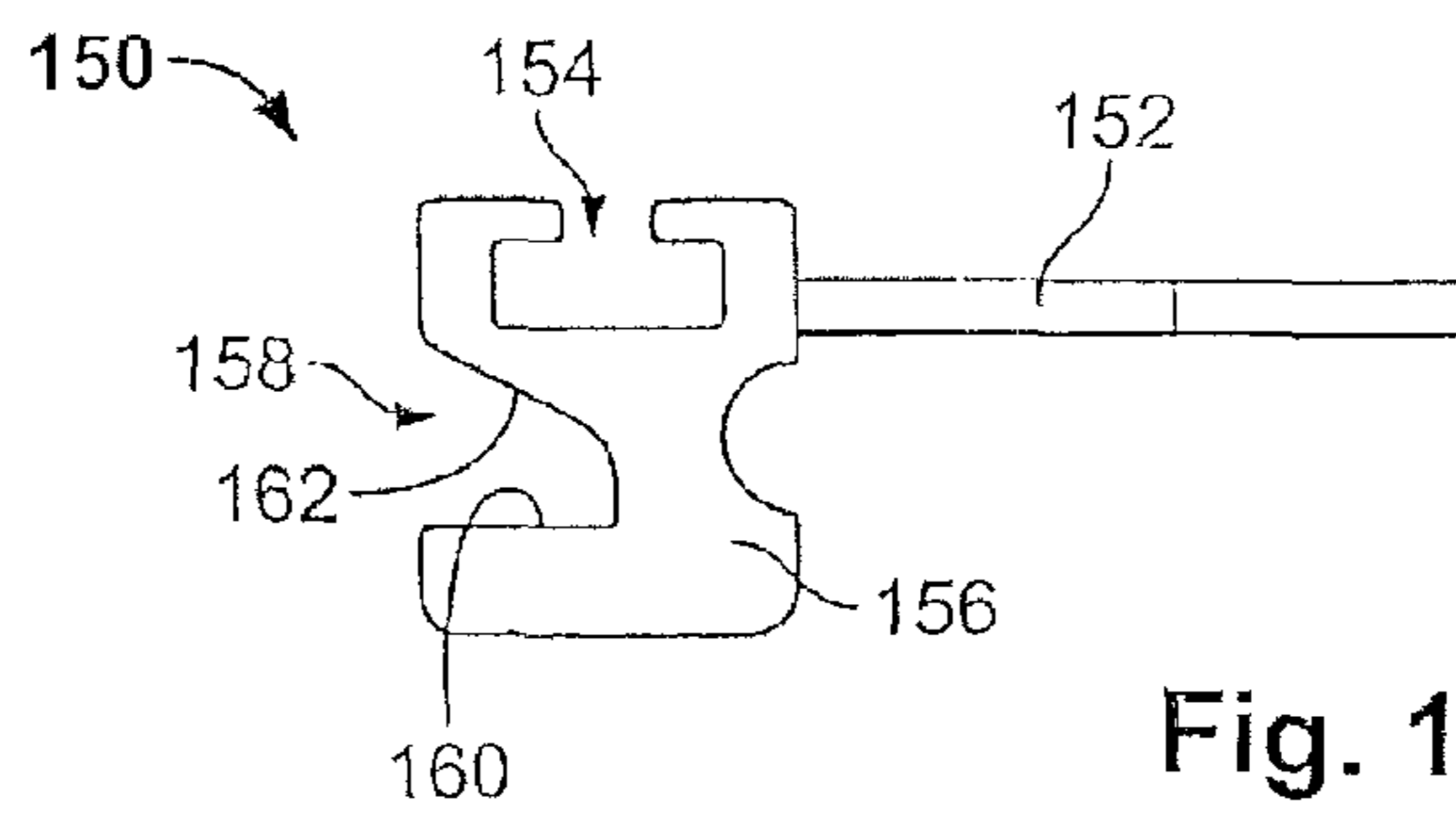


Fig. 10

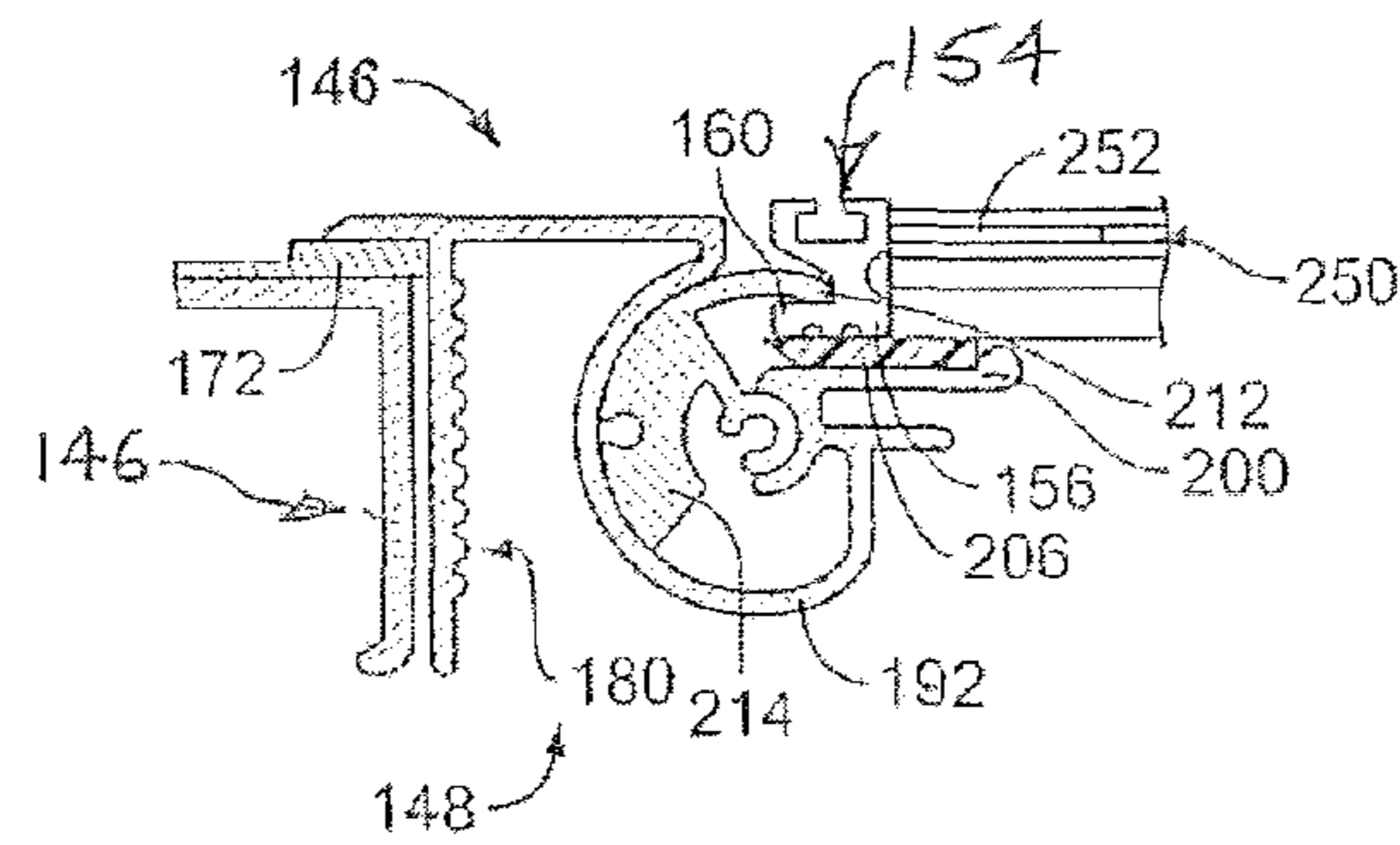


FIG. 11

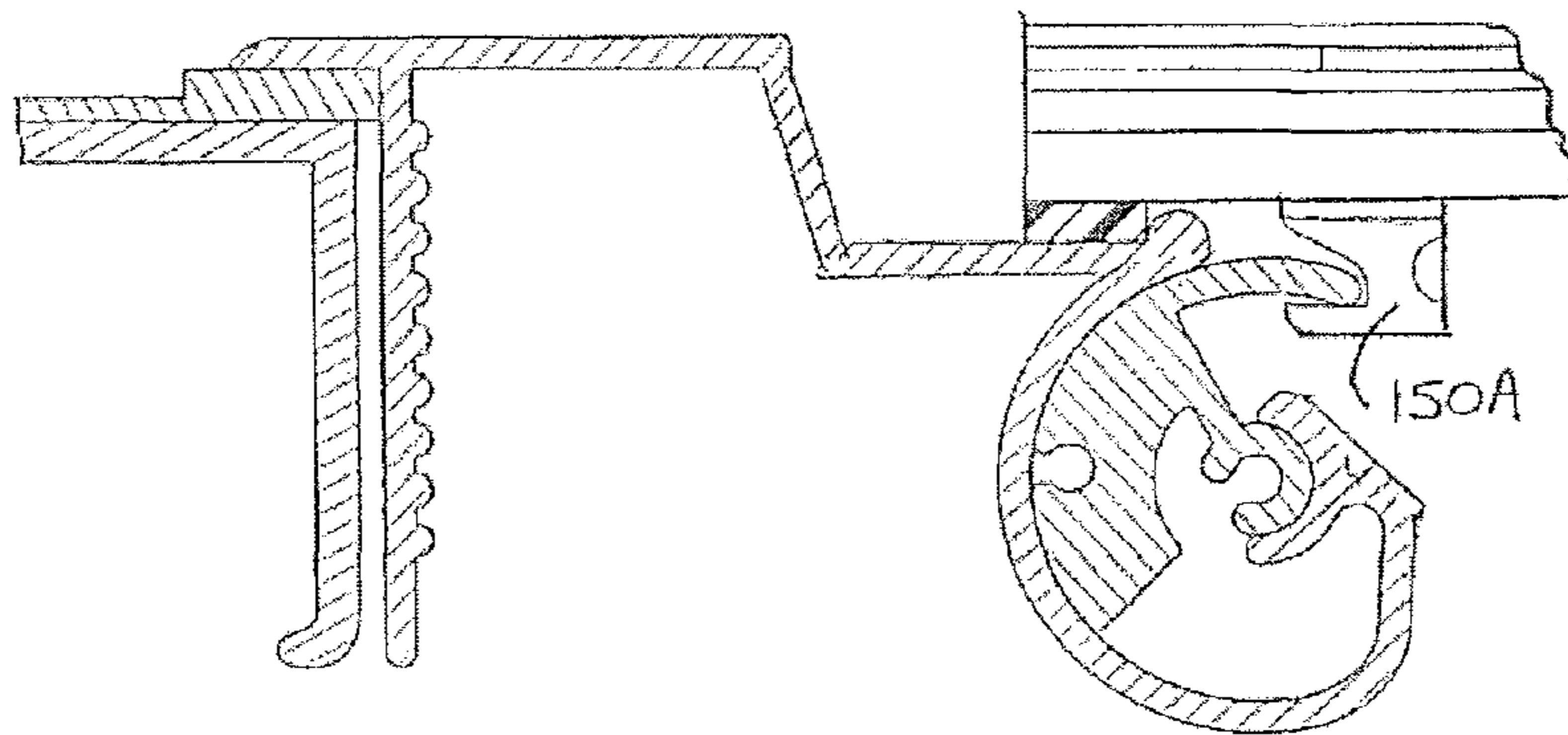


FIG. 11A

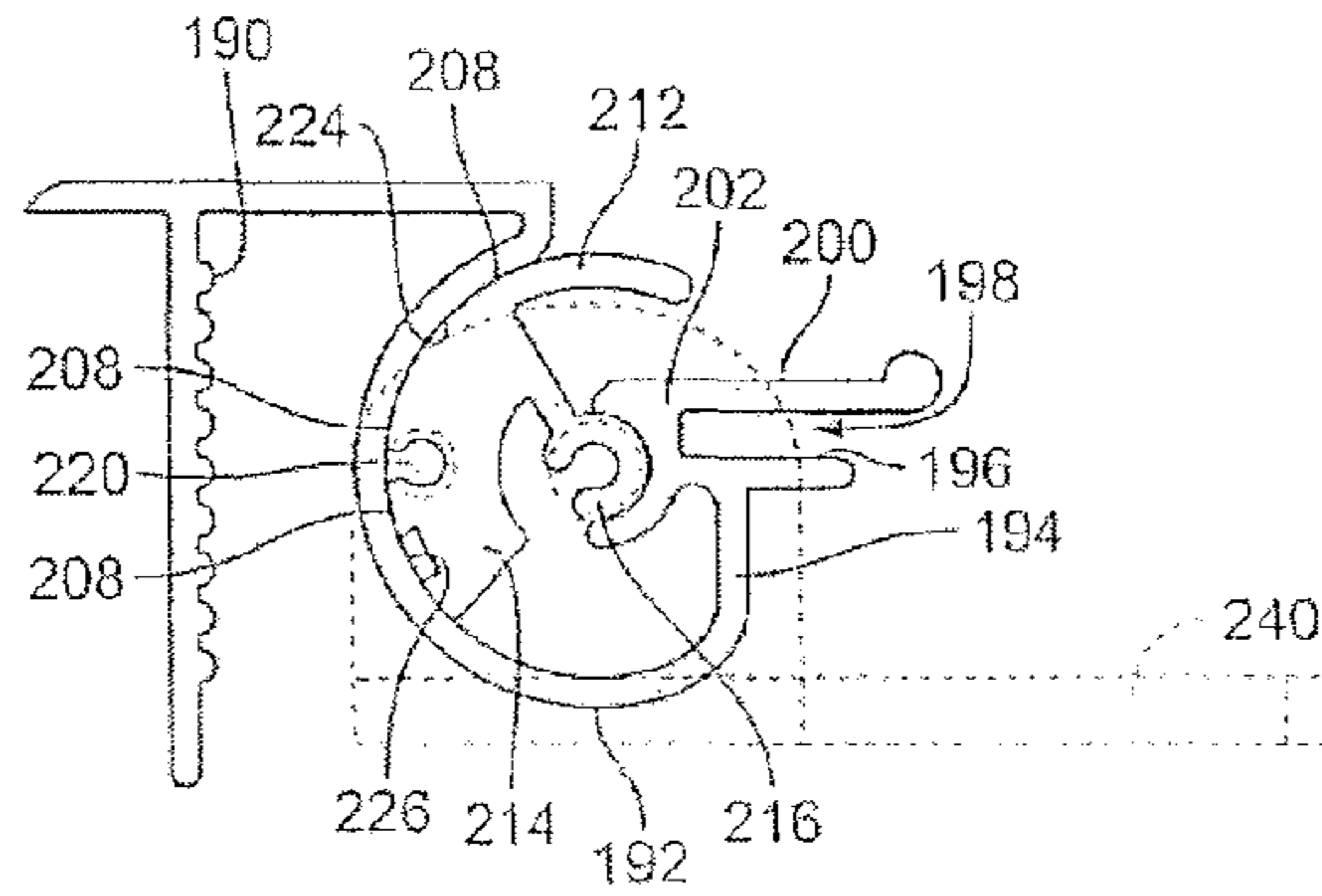


FIG. 12

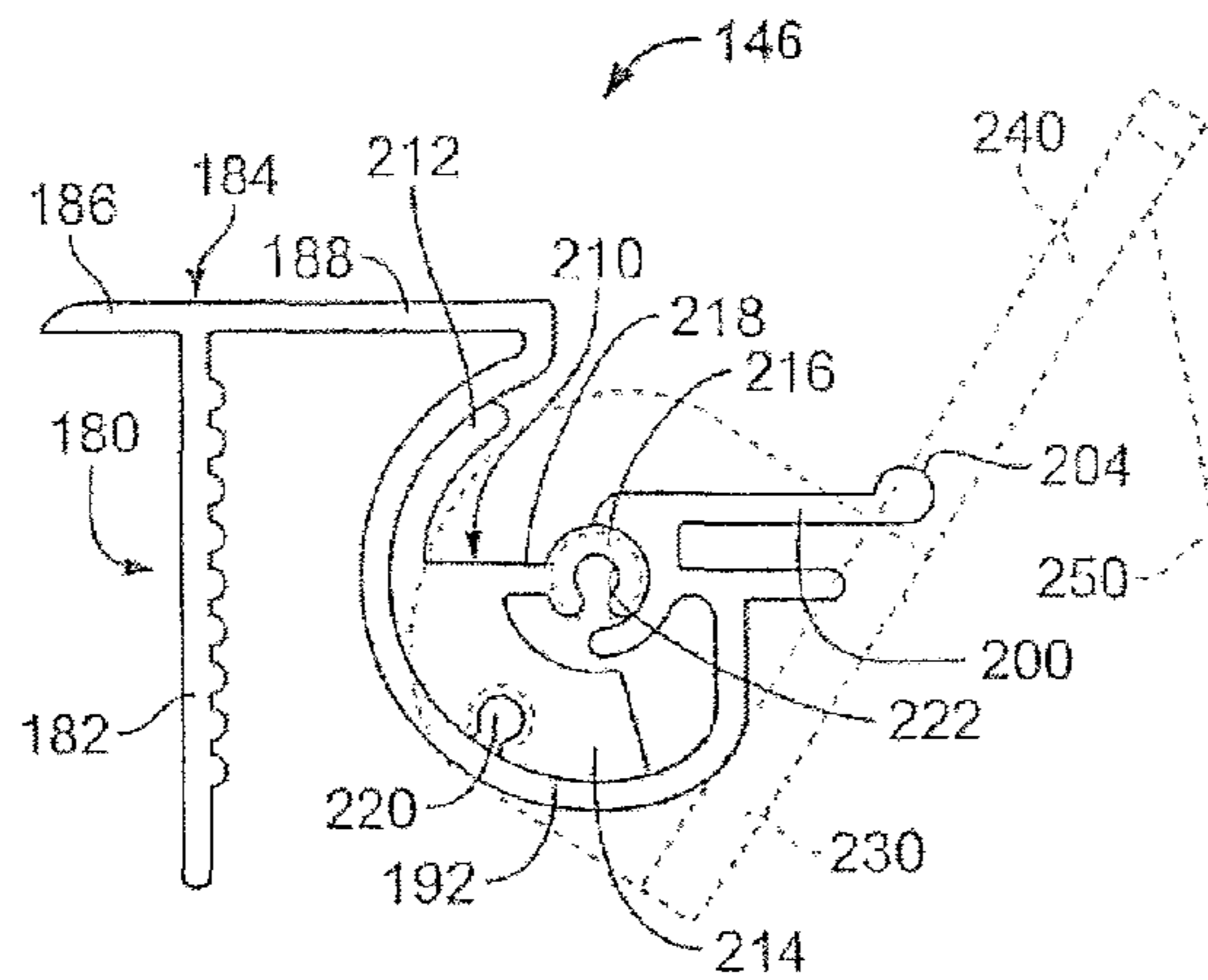


FIG. 13

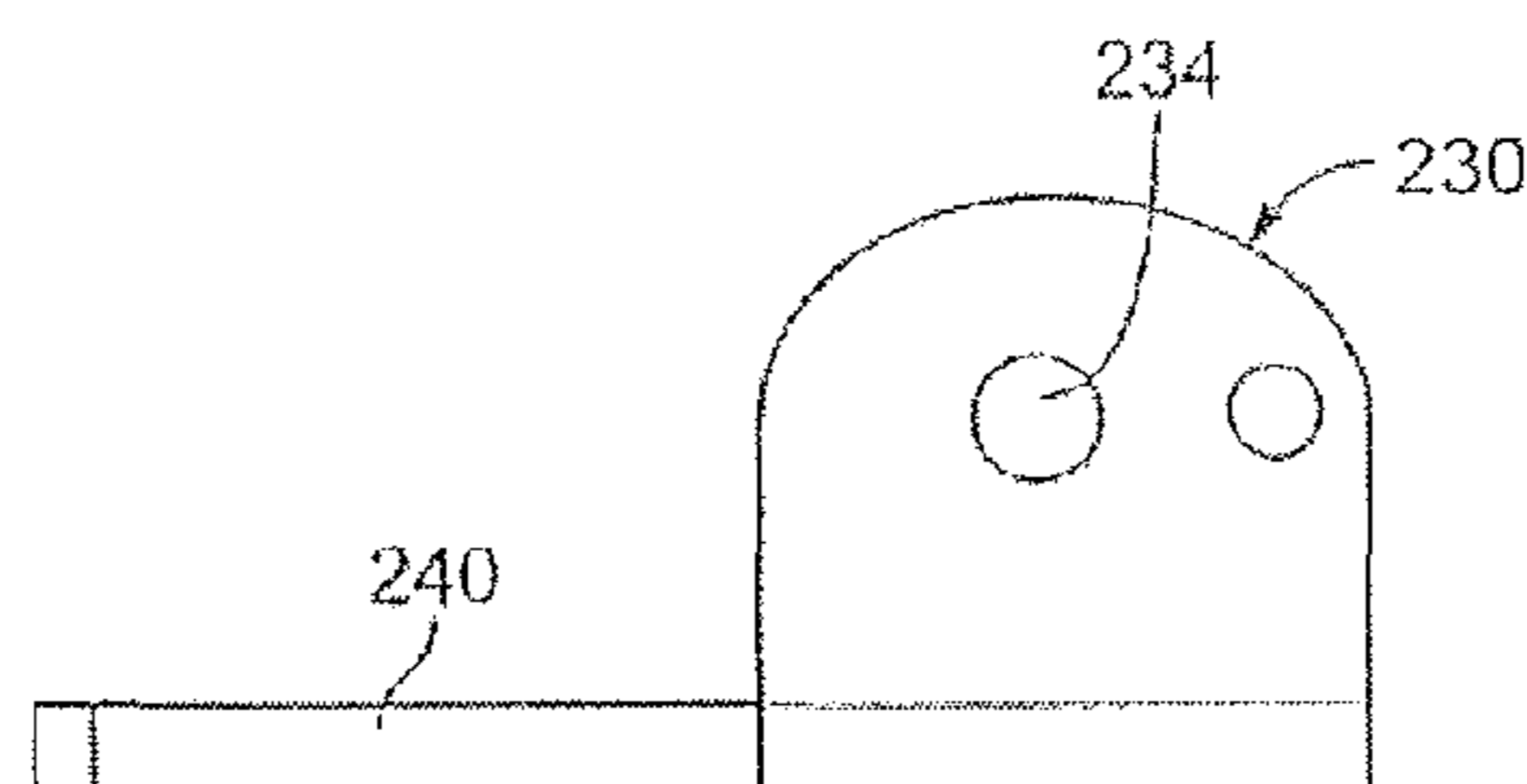


FIG. 14

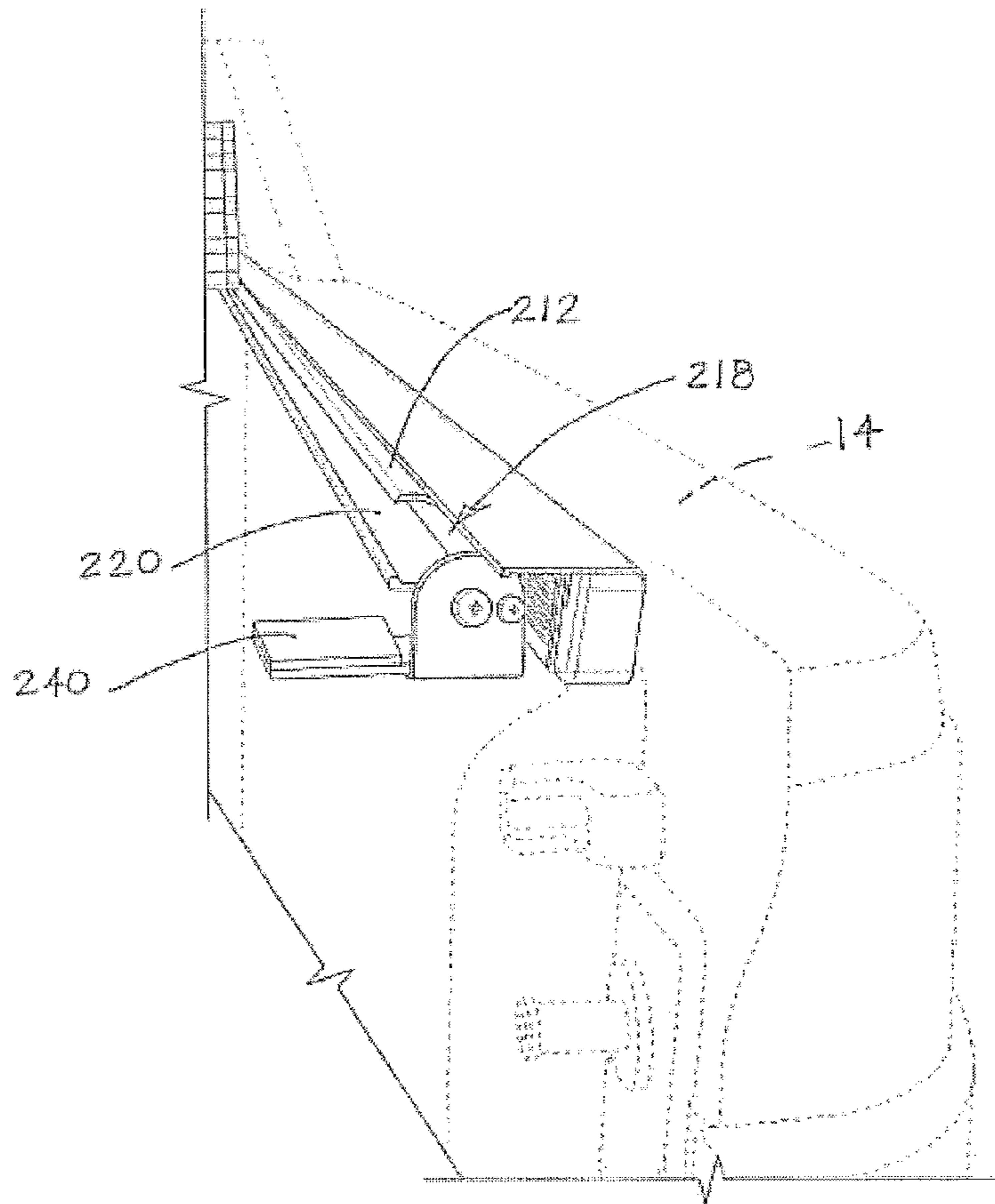


FIG. 15

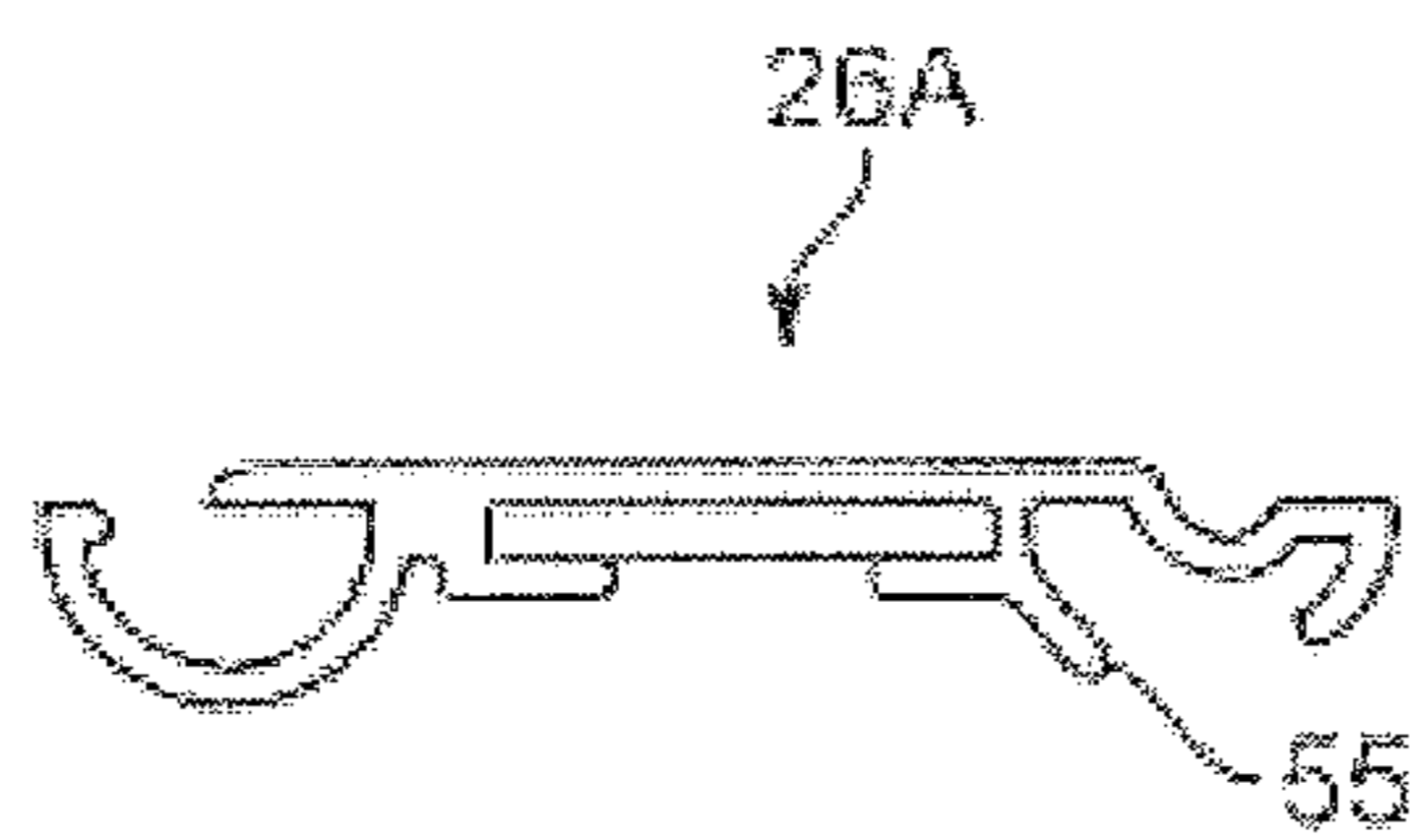


FIG. 16

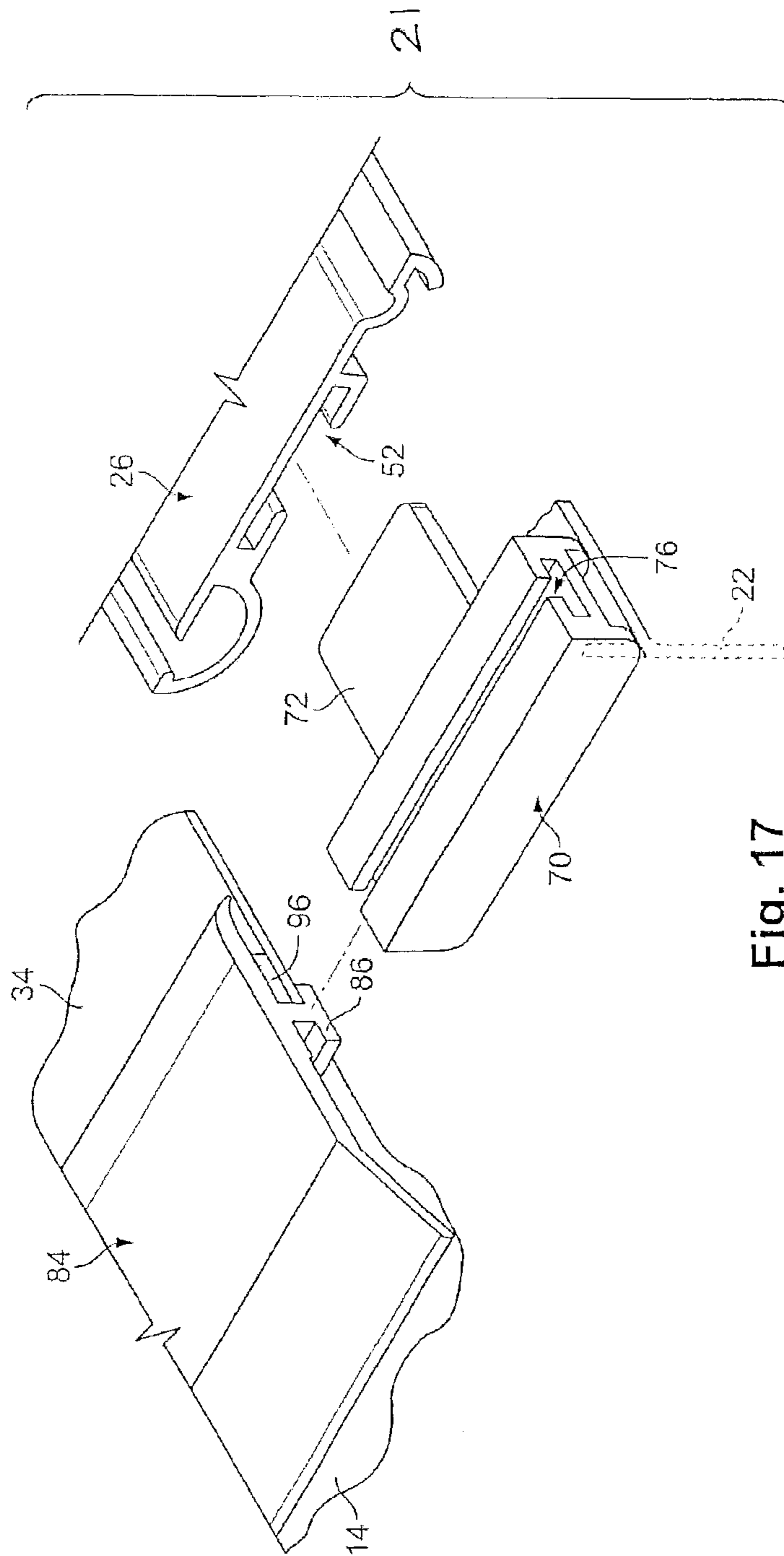


Fig. 17

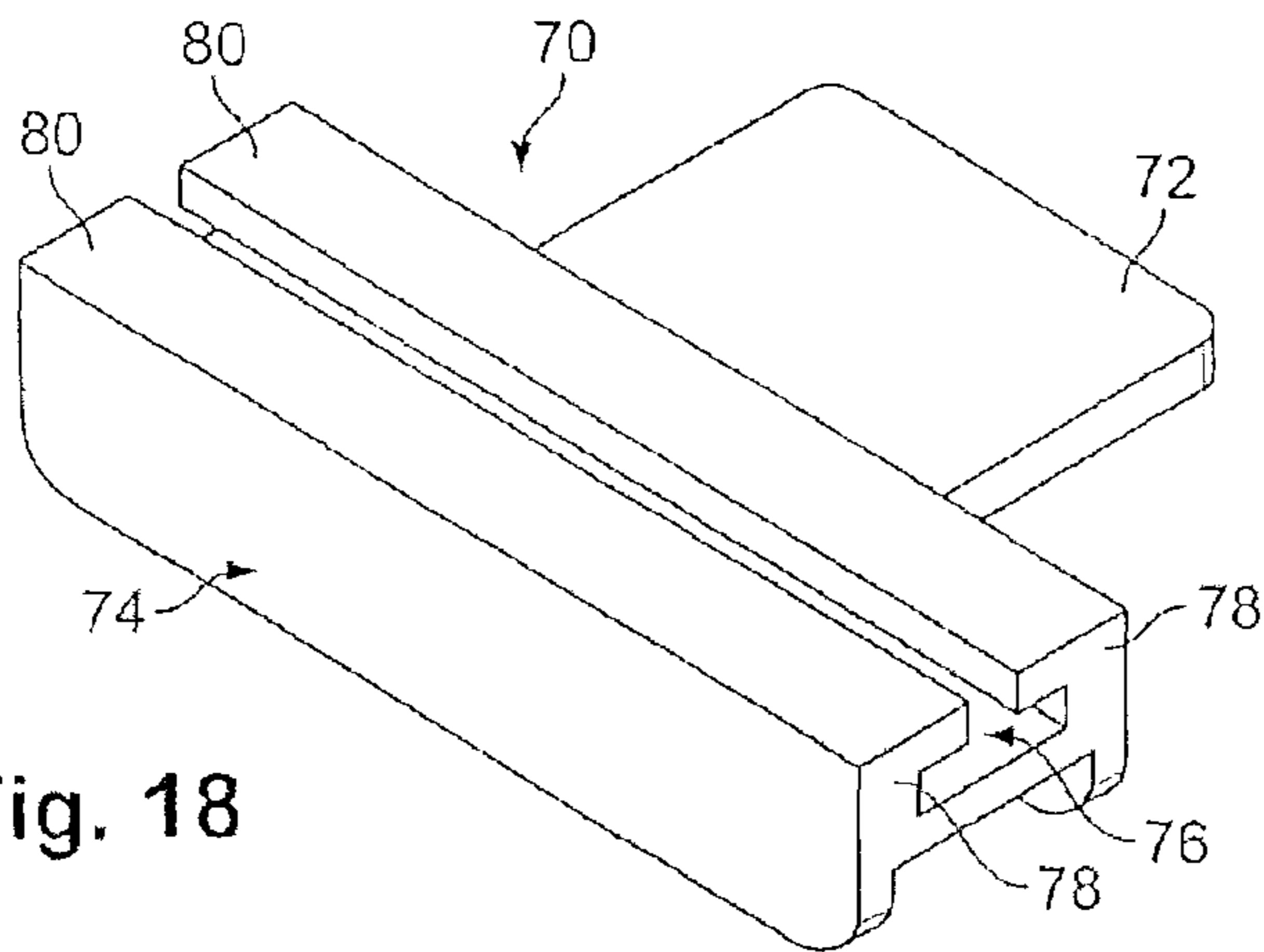


Fig. 18

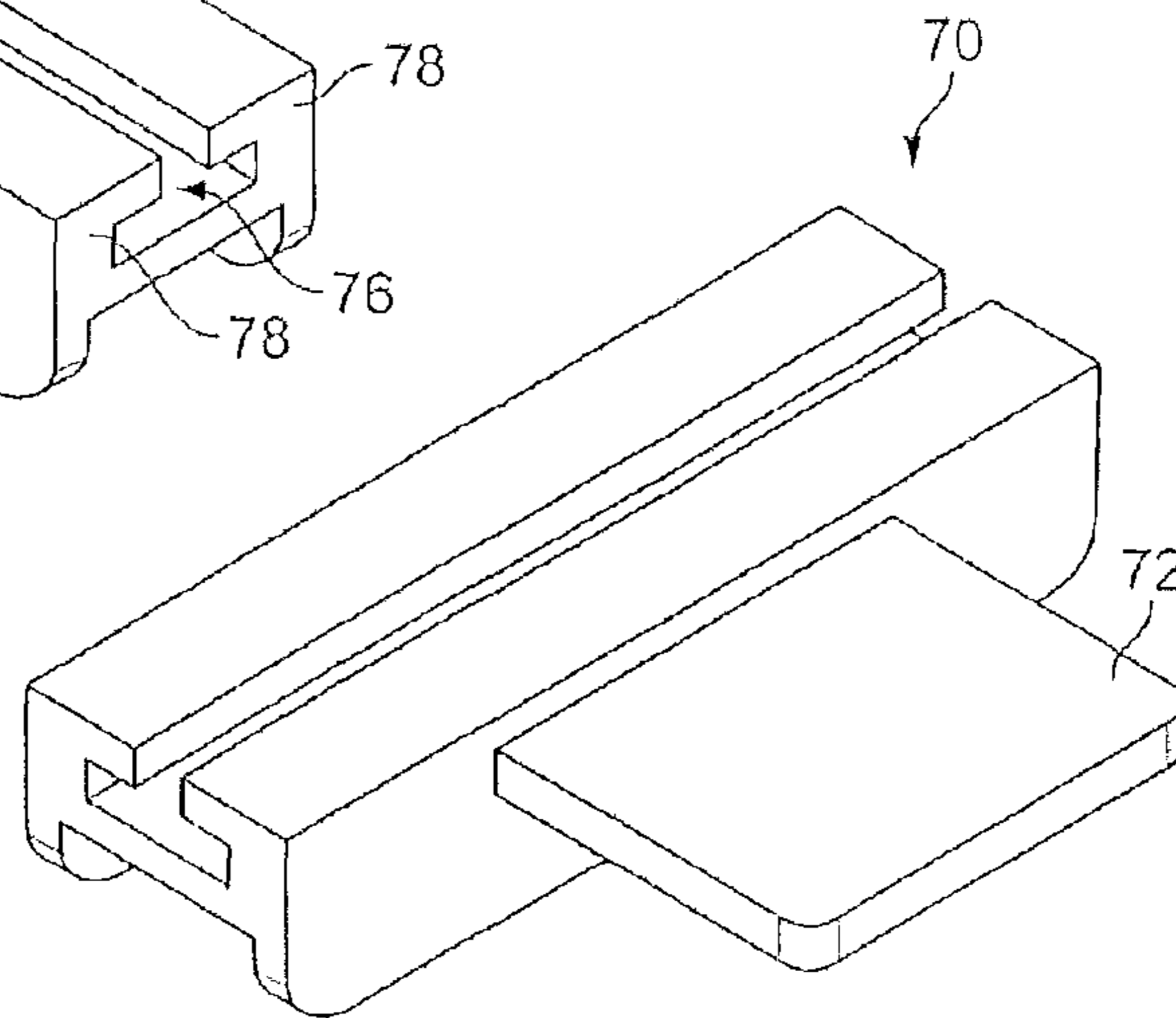


Fig. 19

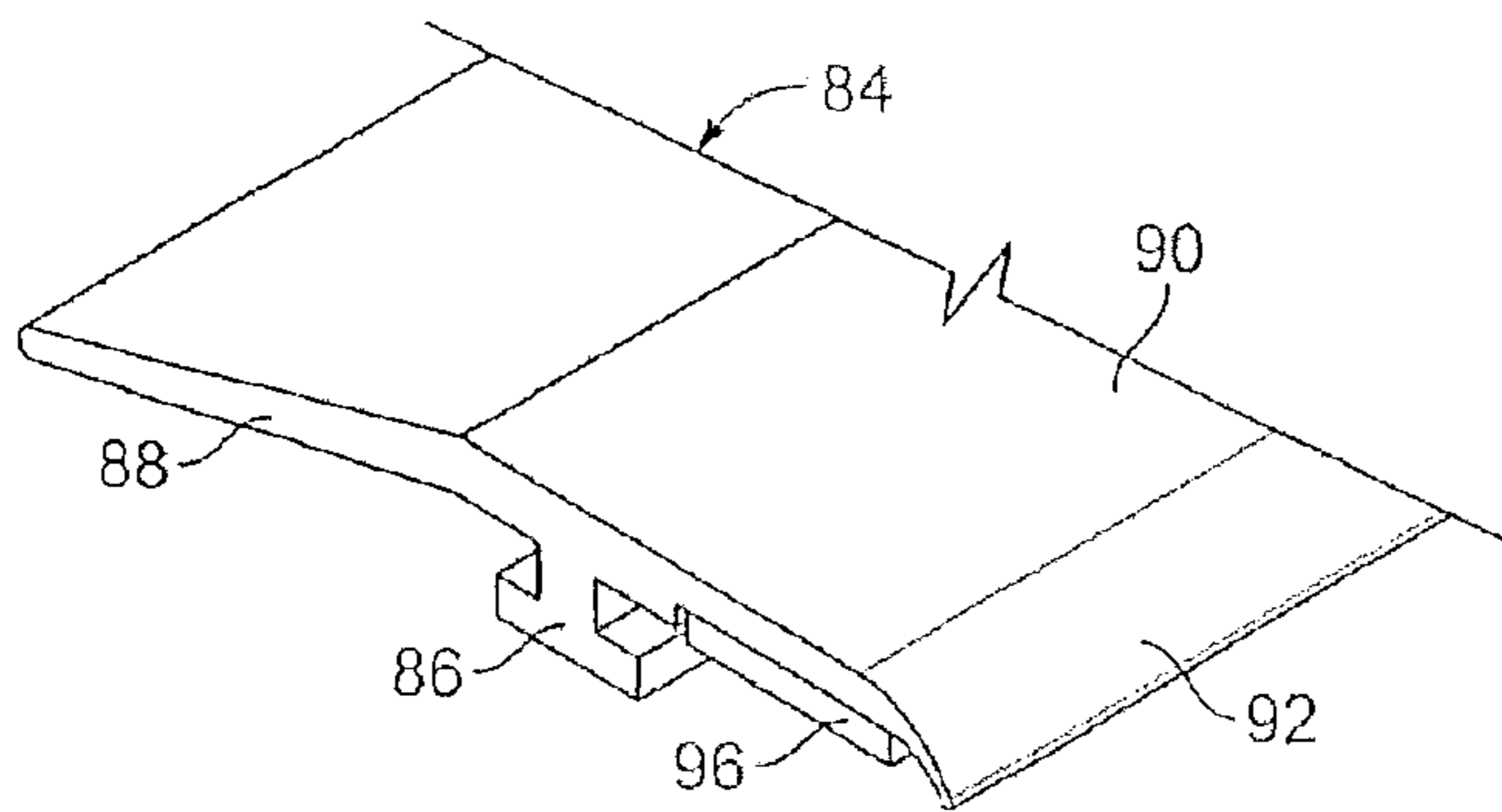


Fig. 20

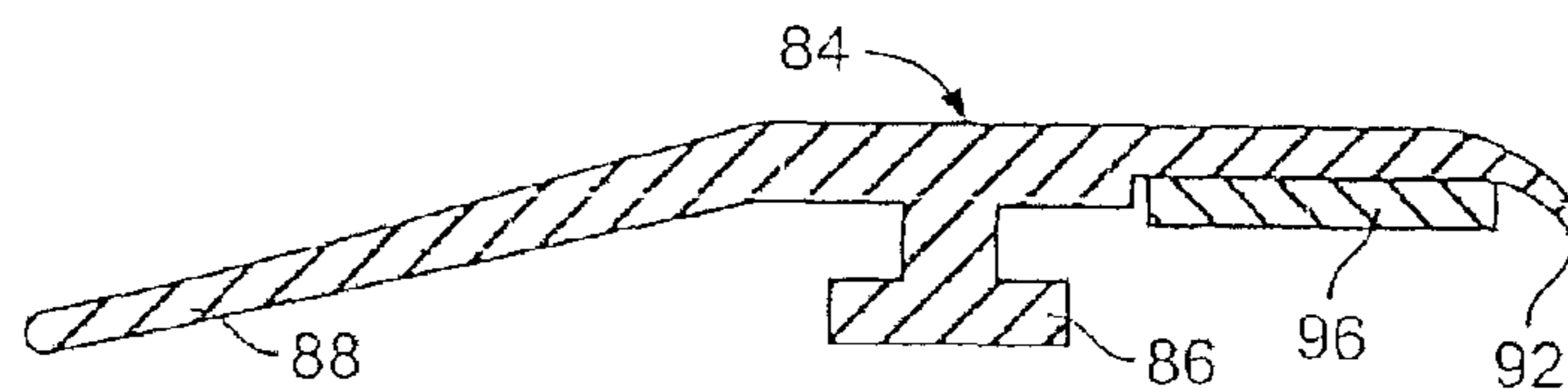
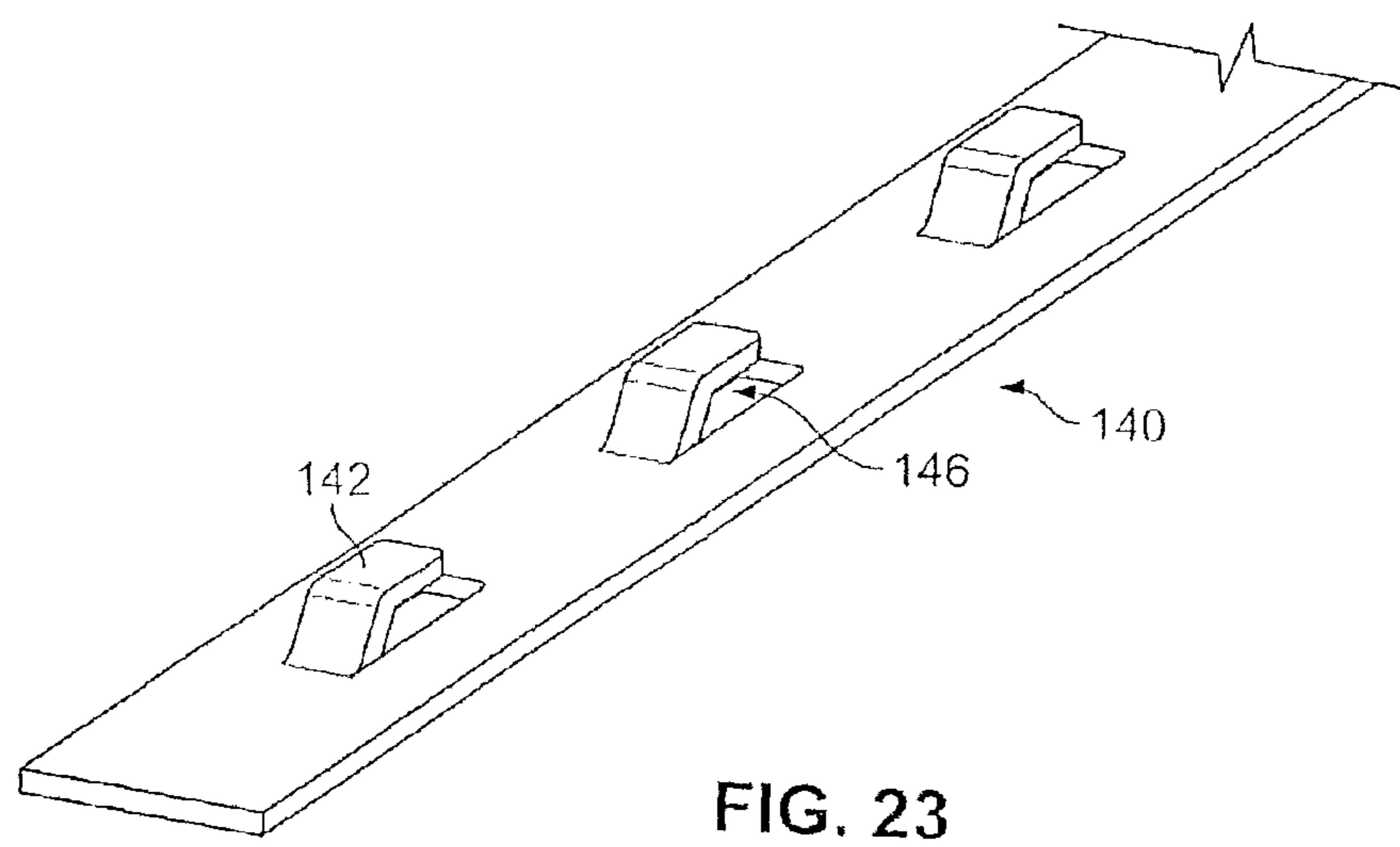
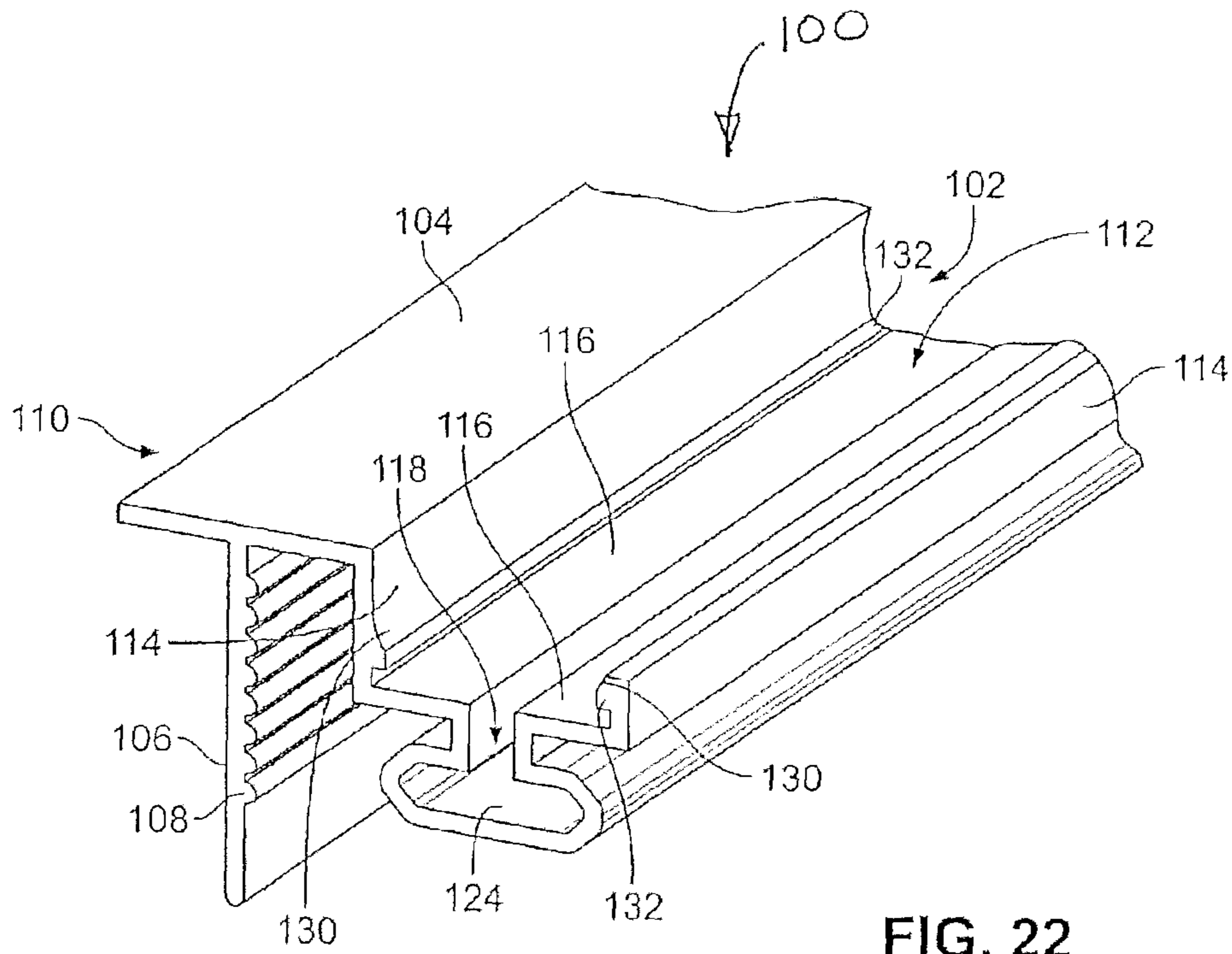


FIG. 21



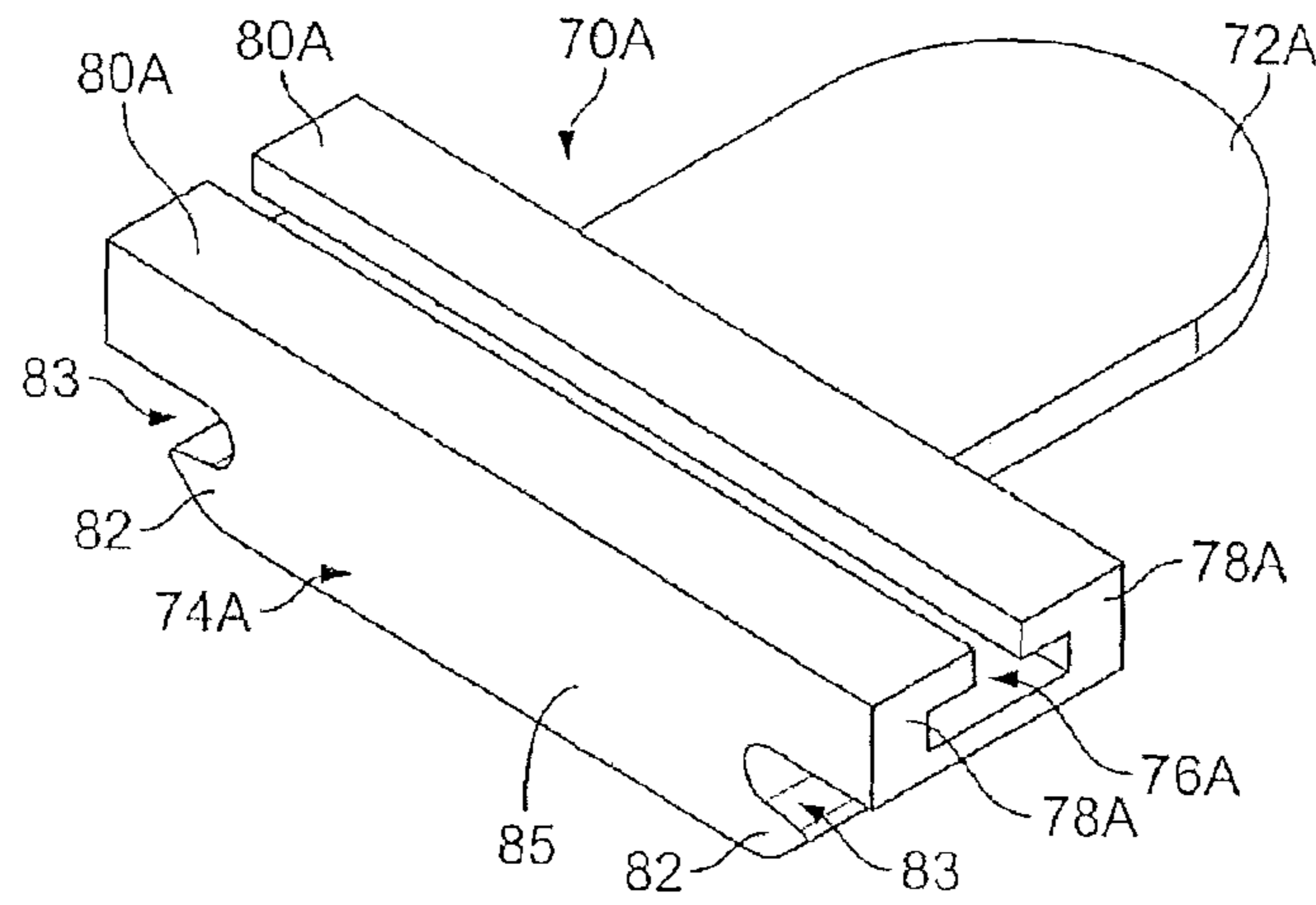


FIG. 24

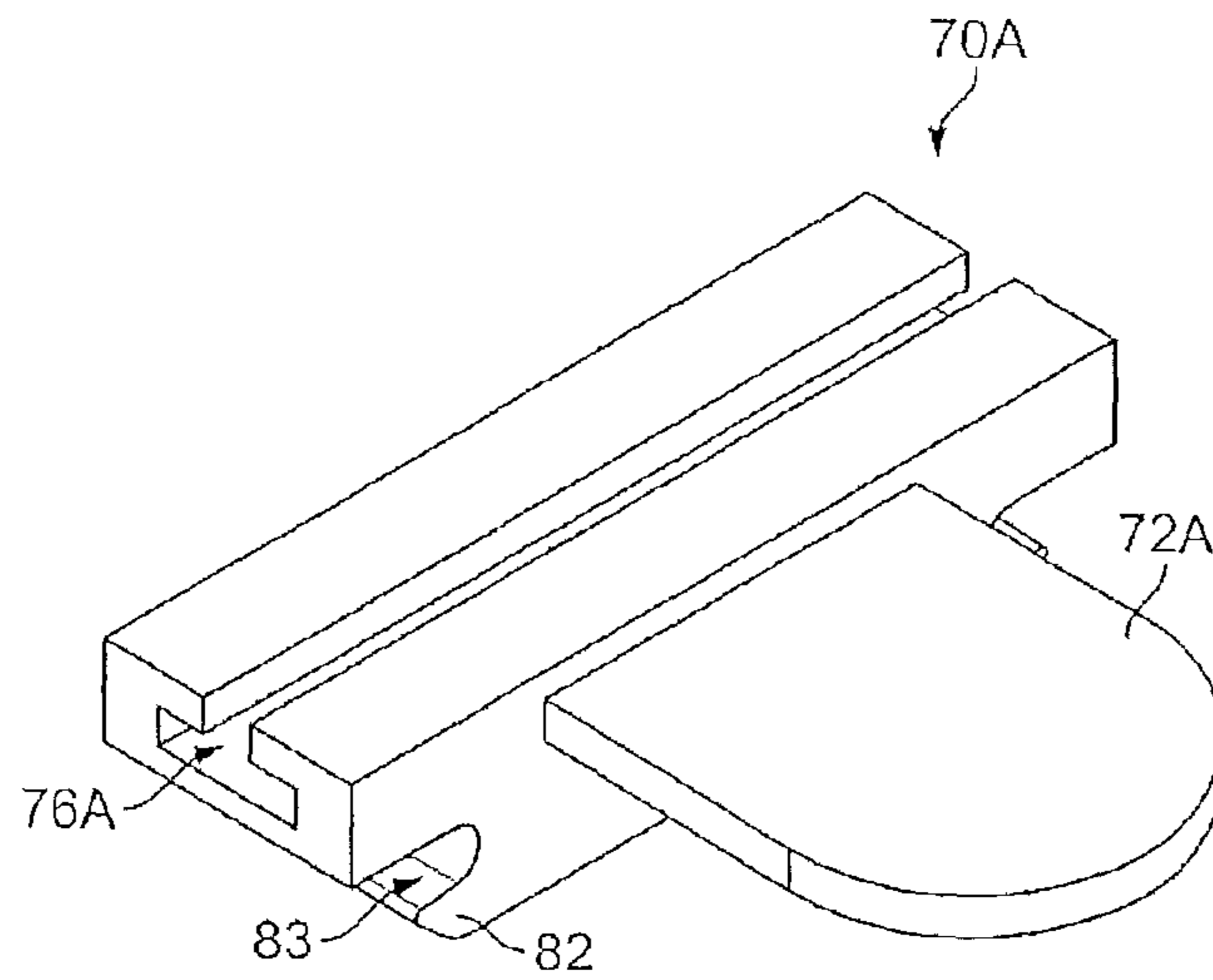


FIG. 25

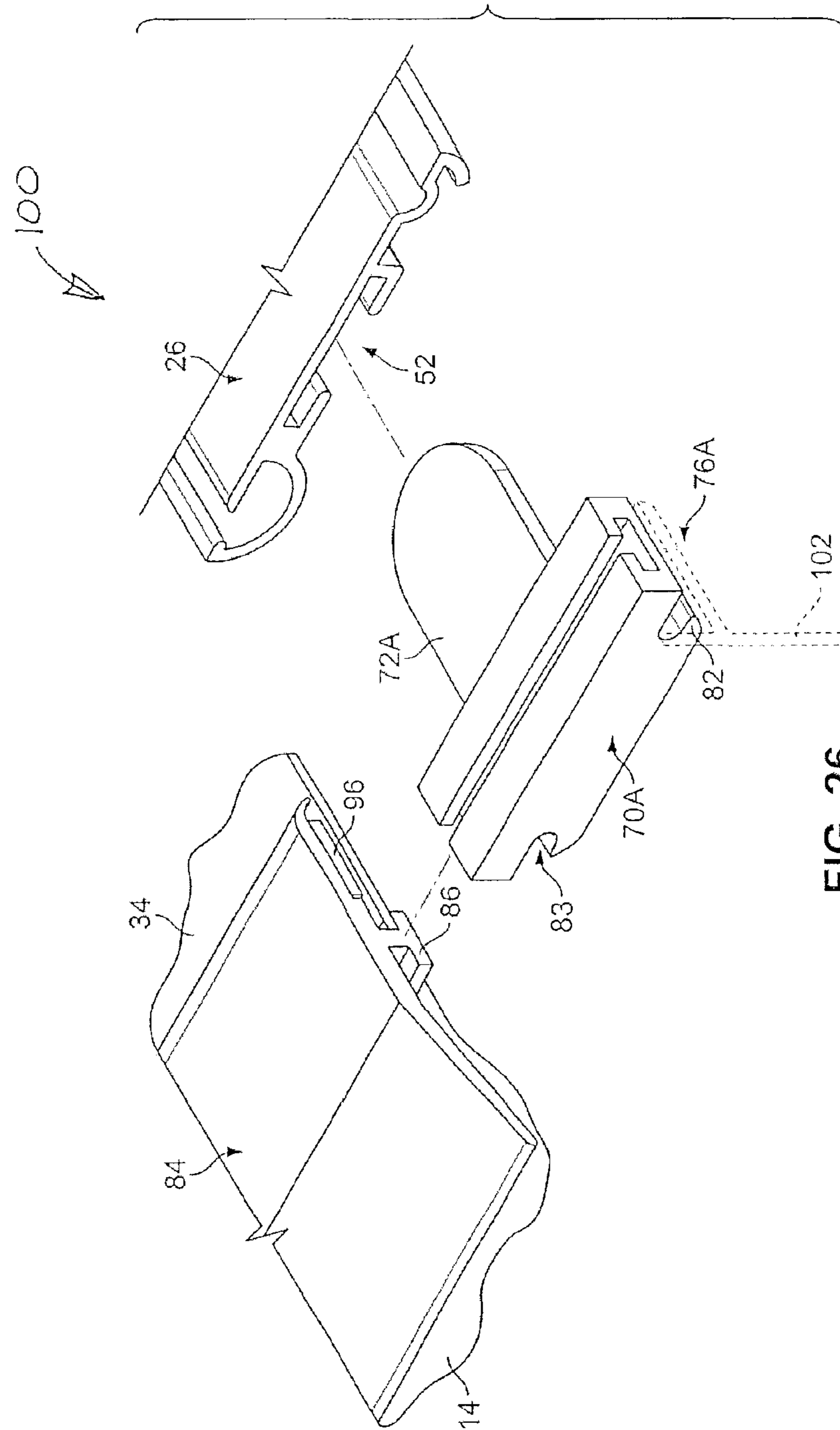
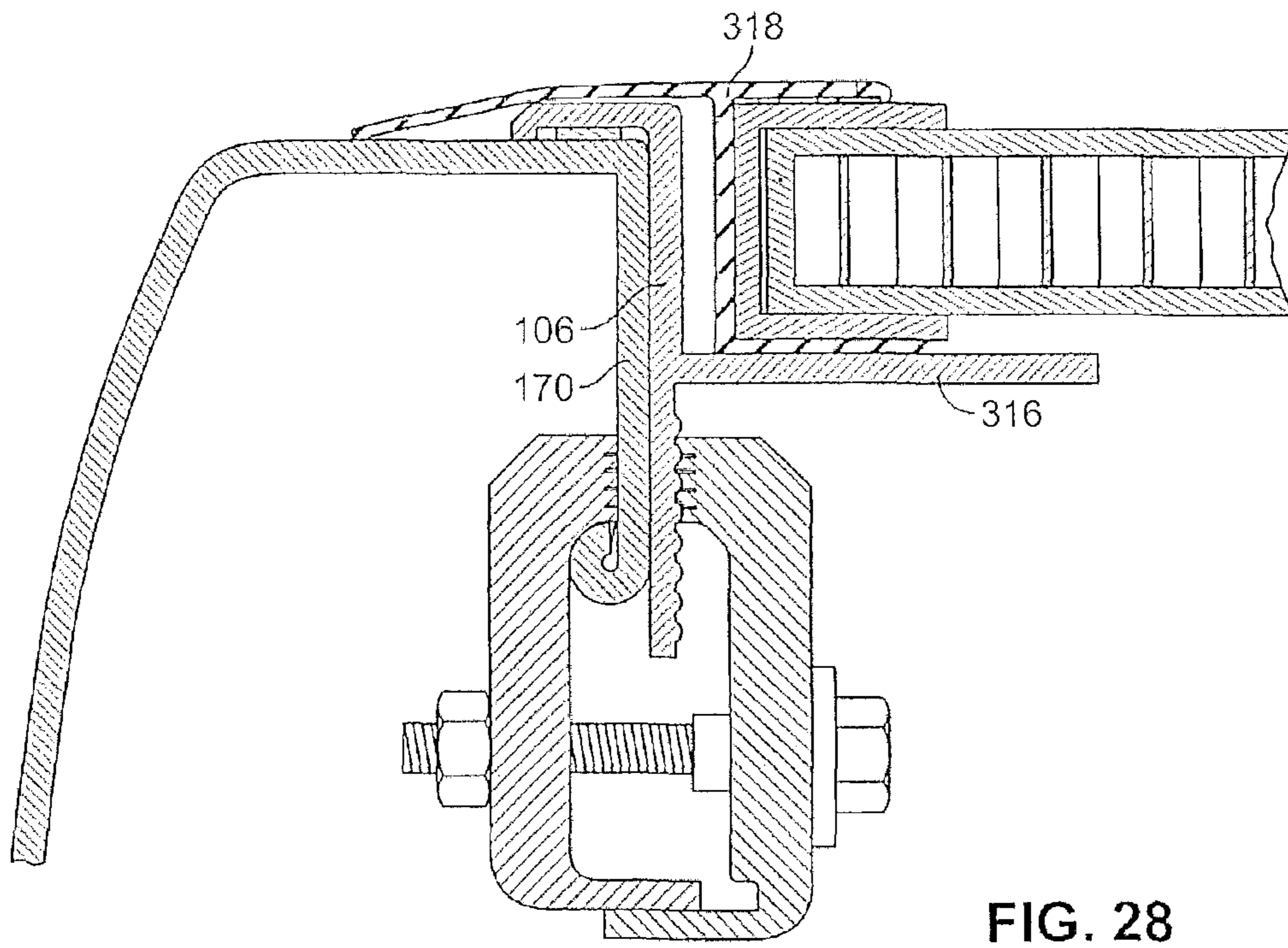
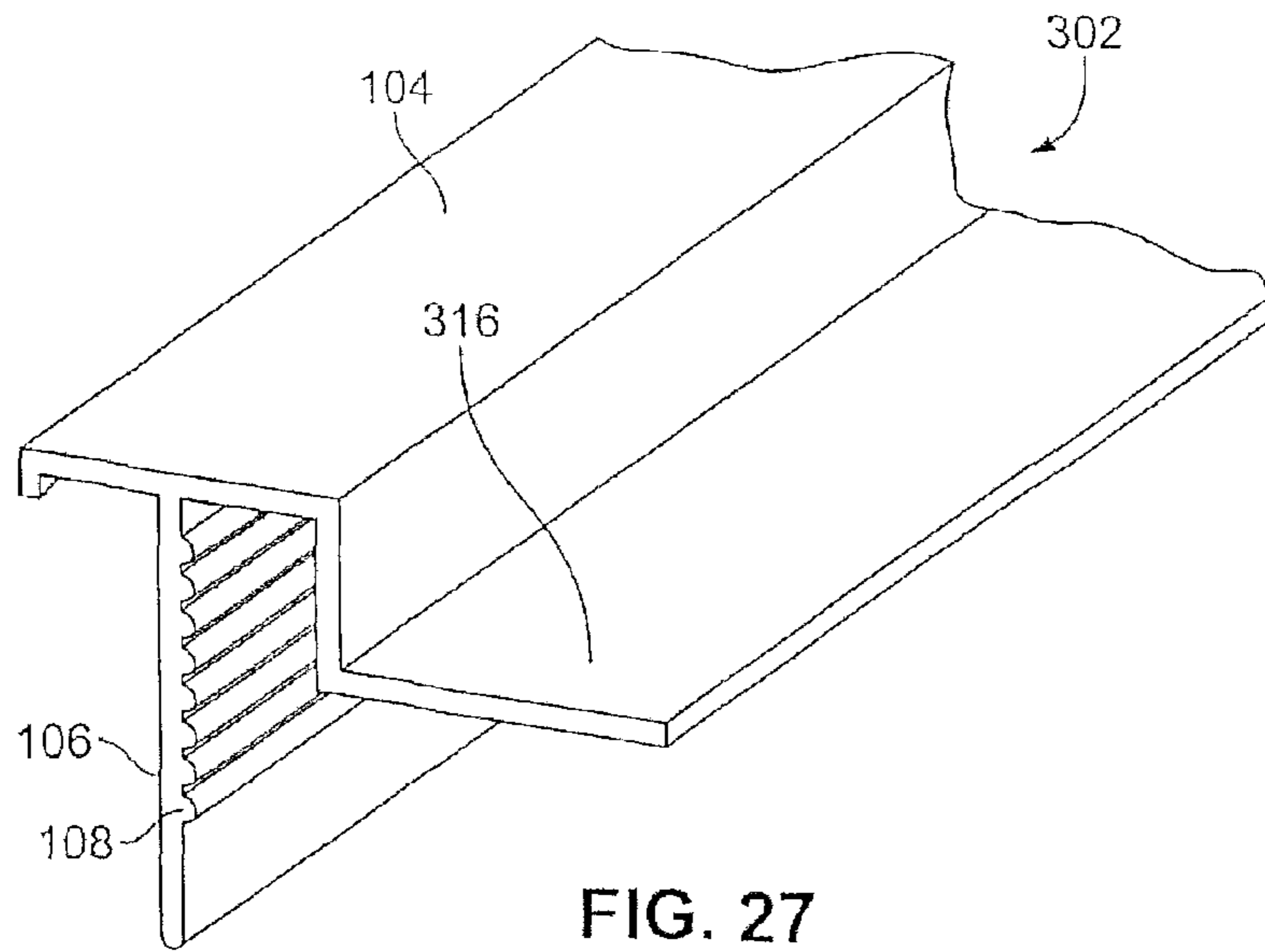


FIG. 26



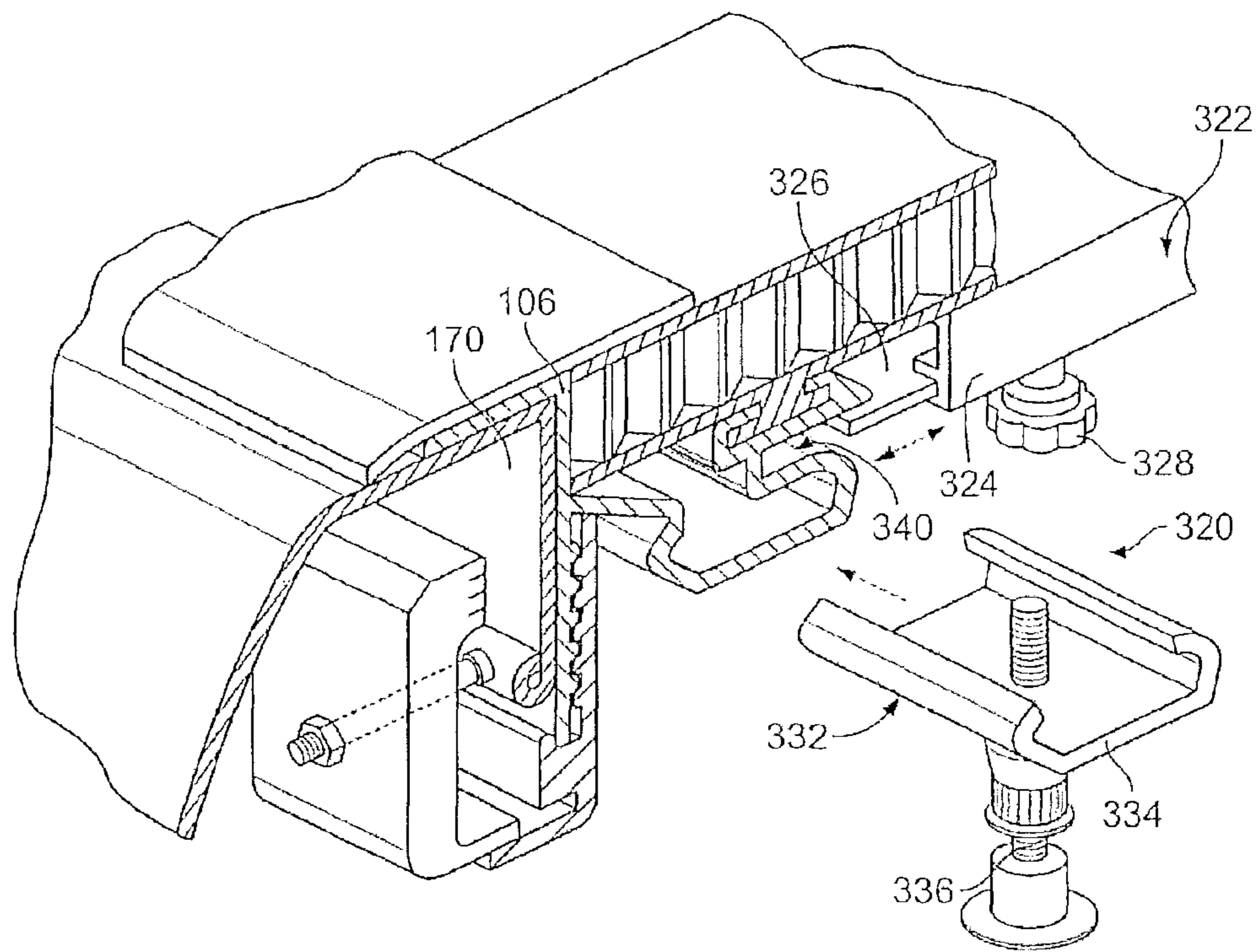


FIG. 29

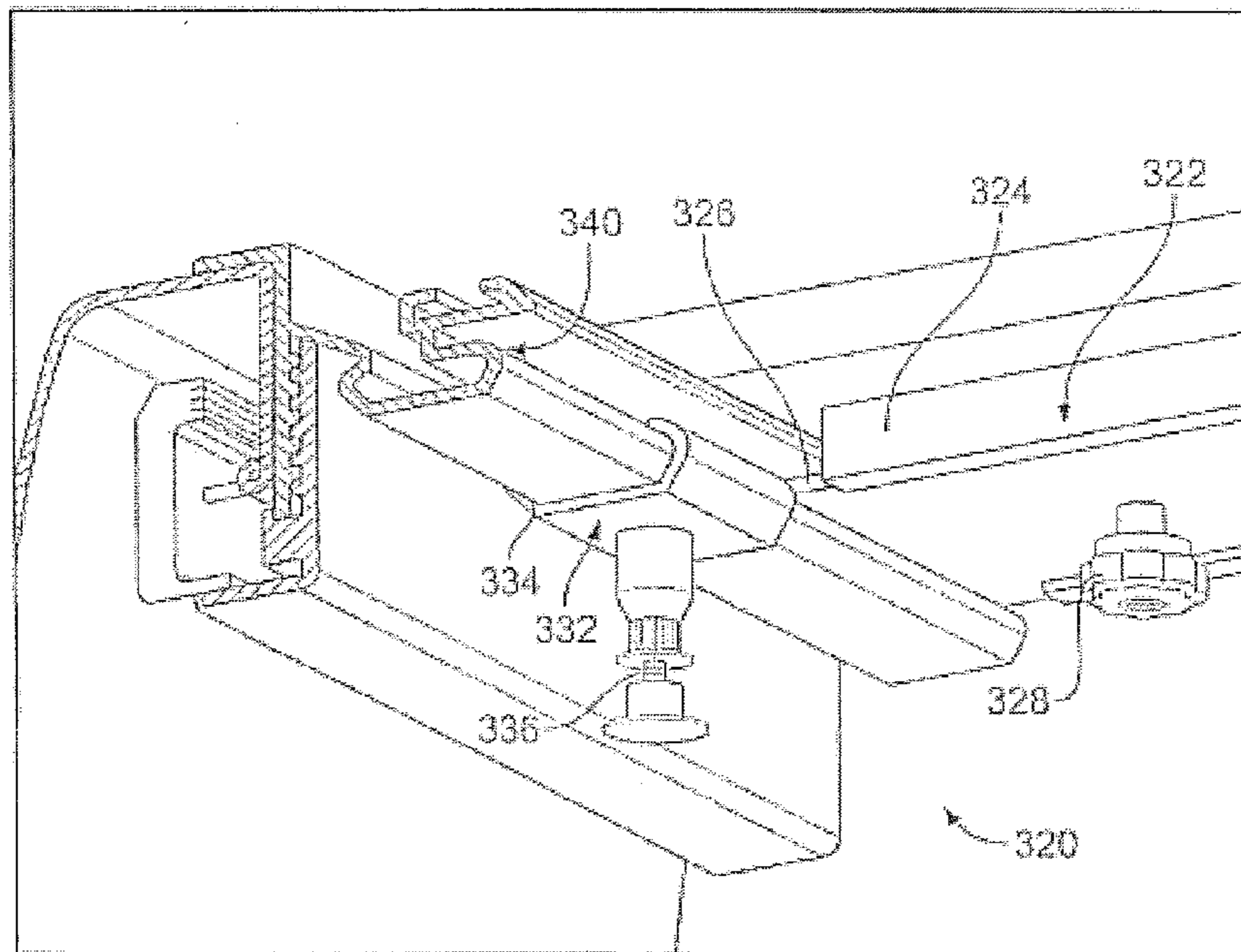


FIG. 30

TRUCK BOX COVER WITH LOCK DOWN ELEMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 14/590,121 filed Jan. 6, 2015, now U.S. Pat. No. 9,278,611, which is a continuation of U.S. patent application Ser. No. 14/011,523 filed Aug. 27, 2013, now U.S. Pat. No. 8,939,494, which is a continuation of U.S. patent application Ser. No. 13/653,766 filed Oct. 17, 2012, now U.S. Pat. No. 8,544,934, which claims the benefit of U.S. Provisional Patent Application Nos. 61/553,828 filed Oct. 31, 2011; 61/553,885 filed Oct. 31, 2011; 61/553,814 filed Oct. 31, 2011; 61/602,280 filed Feb. 23, 2012; and 61/621,921 filed Apr. 9, 2012. The entire disclosures of the above applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Pick-up trucks are one of the most popular and versatile vehicles in use today. Pick-up trucks typically have an enclosed cab and an open cargo box in the rear of the truck. The open cargo box allows all types of things to be quickly and easily loaded, carried and unloaded. Despite this versatility, the open cargo box has significant disadvantages. First, with the box tailgate closed, the box creates significant air turbulence and drag on the truck, especially at high speeds. This reduces the fuel efficiency of the vehicle and may also add to the noise level within the cab. Another disadvantage is the complete lack of security. Anything in an open box can be easily stolen. The open cargo box also leaves the contents of the box exposed to the weather.

Various types of box covers have been proposed to overcome these problems, including single piece covers as well as folding, retracting, and roll-up covers in so-called hard cover designs made of metal, fiberglass, and plastic, and/or so-called soft cover designs made of fabric. Still, disadvantages remain, including inadequate security, leaking, difficulty in installation and/or use. Accordingly, an improved pick-up truck cargo box cover is needed.

SUMMARY OF THE INVENTION

According to aspects of the present disclosure, a cover assembly for a vehicle box can include a plurality of rigid rectangular elements. The plurality of rigid rectangular elements can be pivotally connected together and movable between a closed position wherein the plurality of rigid rectangular elements are deployed for covering the vehicle box, and an open position wherein the plurality of rigid rectangular elements are retracted to allow access to the vehicle box. The cover assembly can additionally include first and second side rails attachable to the vehicle box. At least one side rail of the first and second side rails can include a movable locking element movable between a locked position in which the movable locking element secures at least one of the rigid rectangular elements in the closed position to restrict movement of the at least one of the rigid rectangular elements away from the at least one side rail, and an unlocked position in which the movable locking element does not restrict movement of the at least one of the rigid rectangular elements.

According to aspects of the present disclosure, a cover assembly for a vehicle box having a forward end and a rear end can include a plurality of slats. The plurality of slats can

be pivotally connected together and movable between a closed position wherein the slats are deployed for covering the vehicle box, and an open position wherein the slats are retracted to allow access to the vehicle box. At least one of the slats can include a first end fitting having a first fixed locking element and a second end fitting having a second fixed locking element. The cover assembly can additionally include first and second side rails attachable to the vehicle box with a forward and rear end of each side rail respectively positionable adjacent the forward and rear ends of the vehicle box. Each side rail can include a movable locking element movable between a locked position in which the movable locking element engages an adjacent one of the fixed locking elements to restrict movement of the at least one slat in the closed position away from each side rail, and an unlocked position in which the movable locking element is disengaged from the adjacent one of the fixed locking elements allowing movement of the at least one slat relative to the side rails.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, the same reference number indicates the same element in each of the views.

FIG. 1 is a perspective view of a roll up cover shown in an unrolled position on the box of a pickup truck.

FIG. 1A is a section view taken along line 1A-1A of FIG. 1.

FIG. 2 is a perspective view of the cover of FIG. 1 shown in a fully rolled up position.

FIG. 2A is a perspective view of the cover of FIG. 1 shown in a partially rolled up position.

FIG. 3 is an enlarged perspective view of the cover as shown in FIG. 2, with components removed for purposes of illustration.

FIG. 4 is an enlarged perspective view of two adjoining slats or strips of the cover shown in FIG. 1.

FIG. 4A is a further enlarged end view of two adjoining slats or strips of the cover shown in FIG. 1.

FIG. 5 is a section view of the back end or last slat and two adjoining slats of the cover in the unrolled position as shown in FIGS. 1 and 4.

FIG. 6 is a section view of three adjoining slats of the cover in the rolled up position as shown in FIGS. 2 and 3.

FIG. 7 is a bottom perspective view of an end fitting for use with the roll up cover shown in FIGS. 1-6.

FIG. 8 is a right side view of the end fitting shown in FIG. 7.

FIG. 9 is a front view of the end fitting shown in FIGS. 7 and 8.

FIG. 10 is an end view of the end fitting shown in FIGS. 7-9.

FIG. 11 is a section view of one side of the roll up cover assembly of FIGS. 1-9 shown in the locked position.

FIG. 11A is a section of one side of an alternative design roll up cover assembly.

FIG. 12 is a section view of the side rail of the cover assembly shown in FIG. 11 in an intermediate position.

FIG. 13 is a section view of the side rail of the cover shown in FIG. 11 in an open or unlocked position.

FIG. 14 is an end view of the drive plate shown in FIGS. 12 and 13.

FIG. 15 is a perspective view of the side rail of the cover assembly shown in FIGS. 1-14.

FIG. 16 is an end view of an alternative slat design.

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FIG. 17 is an exploded perspective view of an alternative embodiment showing an end fitting attached to a slat and a seal strip attached to the end fitting.

FIG. 18 is a front perspective view of the end fitting shown in FIG. 17.

FIG. 19 is a rear perspective view of the end fitting shown in FIG. 18.

FIG. 20 is an end perspective view of the seal strip shown in FIG. 17.

FIG. 21 is a section view of the seal strip shown in FIG. 17.

FIG. 22 is a perspective view of another alternative embodiment side rail.

FIG. 23 is a perspective view of a hook strip for use with the side rail shown in FIG. 22.

FIG. 24 is a front perspective view of an end fitting for use with the side rail shown in FIG. 22.

FIG. 25 is a side perspective view of the end fitting shown in FIG. 24.

FIG. 26 is an exploded perspective view showing the attachment of the end fitting to a slat of a cover for use with the side rails of FIG. 22, and showing a seal strip attached to the end fitting shown in FIGS. 24 and 25.

FIG. 27 is a perspective view of an alternative side rail without a drain channel.

FIG. 28 is a section view showing an alternative cover on the side rail of FIG. 27.

FIGS. 29 and 30 are perspective section views of an alternative design for attaching a roll-up or folding cover to side rails, without using any fasteners extending through the cover.

DETAILED DESCRIPTION OF THE DRAWINGS

As shown in FIGS. 1-2A, a cover assembly 15 includes a roll up cover 20 and side rail assemblies 148 attached on opposite sides of the box 12 of a pickup truck 10. The cover 20 may be rolled up from a deployed or unrolled position shown in FIG. 1, to a rolled up position shown in FIG. 2, or to an intermediate position as shown in FIG. 2A. In the unrolled position shown in FIG. 1, the cover 20 is supported on side rails 180 of the side rail assemblies 148. The cover 20 may have seal strips 84 on each side overlying the box rails 14 of the box 12. The side rail assemblies 148 may be attached to the box rails 14 via clamping, for example as described in U.S. Pat. No. 7,537,264, incorporated herein by reference. A rear seal flap 151 on the back slat 27 may resiliently press onto and seal against the top or other surface of the tailgate 16.

As shown in FIG. 2, strips of felt 25 or other material may be attached onto the bottom surface of the cover 20 to provide a handling surface. The cover 20 can then be rolled and unrolled without the need for the user's hand to touch the slats 26, which may become uncomfortably hot to the touch on hot sunny days.

The cover 20 is formed of interlocking or pivotally attached slats 26, which may be extrusions, such as aluminum alloy extrusions. FIG. 4 shows two adjacent slats 26. The width of the slats 26 (i.e. the dimension in the front/back direction of the truck 10 as shown in FIGS. 1-2A) may vary between 1 and 8 inches, with typical covers having slats that are 1.5 to 2.0 inches wide. Narrower slats may allow the cover 20 to roll up into a smaller diameter, allowing for more compact storage.

Most pickup truck boxes have a length varying between about 60 and 100 inches. As one example, using slats 2.0 inches wide, a cover for a 60 inch box would have about 30

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slats, while a cover for a 100 inch box would correspondingly have about 50 slats. The height or thickness of the slats HH in FIG. 5 may range from about 0.18 to 0.6 inches, typically ranging from about 0.2 to 0.4 inches.

A typical cover dimensioned for a 90-100 inch long box may have a diameter when rolled up of less than 14, 12, 10 or 8 inches. This avoids obstructing the rear view from the cab 18. Generally, the headrests on the seats in the cab will be higher than the rolled up cover, to the extent that the rolled up cover may have virtually no effect on the rear view from the cab. Since the cover rolls up and not down, it does not take up any space in the box 12 or require a canister in the box to hold the rolled up cover.

The cover 20 and the side rail assemblies 148 may be dimensioned so that the top surface of the cover 20 is substantially flush with the top surface of the box rails 14. In this case, the cover assembly 15 may present a low-profile streamlined appearance, with the cover only nominally visible when the truck is viewed from the side or rear at eye level. With the cover supported on the side rails 180, and not on the box rails 14, the cover 20 does not obstruct the stake pockets, and it does not interfere with use of bed extenders, bed rails, tie downs, racks, and other accessories. The cover is also easily installed on most or all pick-up trucks, without drilling any holes.

Although the drawings show slats 26 of constant length (extending laterally across the box), covers having slats of varying length may also be used. For example, slats at the back end of the cover, closer to the tailgate 16, may be shorter than the slats closer to the cab 18, so that the length of the slat is proportional to slat position in the coil of slats when the cover is rolled up, as shown in FIG. 3. The width of the slats (in the front/back direction of the box 12) will vary with the width of the box 12, which for most pickup trucks is about 52 to 75 inches. Typically all of the slats have the same width, and the cover 20 is rectangular. FIG. 3 shows the cover 20 with the end fittings 150 removed for purpose of illustration.

Referring still to FIG. 3, a strap 29 may be provided on each side of the cover 20, to hold the cover into the rolled up position. On each side of the cover 20, a fixed end of the strap 29 may be attached to a blind stud 31 or other fitting on the bottom side of the front slat 23 (the forward-most slat on the cover). The fixed end of the strap may optionally be attached to the front end of each side rail 180. With the cover rolled up, the strap 29 may be drawn up and around the cover and releasably attach to a buckle or latch 33 attached to a top surface of the front slat 23, optionally on a short tether 35.

Turning to FIG. 4, all of the slats 26 may optionally have the same design. This allows a single extrusion to cut to the desired length to provide the slats 26. Although designs with slats of two or more different designs may be used, the design shown in FIG. 4 having a single slat design simplifies manufacturing. As shown in FIG. 4, a representative slat 26 has a first side 28, a middle or web section 30 and a second side 32. An inner hinge element 38 is on the first side 28, and an outer hinge element 62 is on the second side 32. The inner hinge element 38 may include a curved or radiused lip 40 attached to a leg 44 on an arc step 46 joined to the web section 30. A groove 36 may be provided on the top of the arc step 46. The arc step 46 positions the flat top surface of the leg 44 slightly below the flat top surface 50 of the web section 32.

Referring still to FIG. 4, the outer hinge element 62 on the second side 32 of the slat 26 may include a curved or radiused hook 66 having an end stop 64. A ledge 60 on the second side 32 may project outwardly partially over the

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hook 66. The inner hinge element 38 is sized and shaped to fit inside of the outer hinge element 62, to form a pivoting hinge joint, generally indicated at element number 24, attaching adjacent slats 26. In the example shown the inner hinge element comprises the lip 40 and leg 44 and the outer hinge element comprises the hook 66 and the end stop 64. However, other hinge elements may alternatively be used. The positions of the elements described may of course also be reversed.

In the example shown, the web section 30 has a flat top surface that is also coplanar with the ledge 60 on the second side 32. As shown in FIG. 4, a slot 52 may be provided on the bottom surface of the web section 30 between an opposing pair of slot arms 54. As shown in FIGS. 5 and 6, a sheet of preferably water impermeable and flexible material 34, such as vinyl, is attached to the flat top surface, e.g., with adhesive. The sheet may extend continuously over substantially the entire top surface of the cover 20, excluding the end fittings. The sheet of material 34 helps to seal the box 14 against egress of water, dust etc., when the cover 20 is closed. The sheet 34 may also optionally be imprinted with decorative designs, images or logos. In an alternative design, separate individual strips of flexible material may be attached over the hinge joints 24.

Turning now also to FIG. 5, with the cover 20 in the flat or unrolled position, the slats 26 may be locked out against downward rolling or curving movement. As shown in FIG. 4A, with the cover unrolled, the top surface 69 of the leg 44 is in contact with the bottom surface 71 of the ledge 60. In addition, the top surface 61 of the stop 64 is in contact with the bottom surface 63 of the web 30. Consequently, in this position, the hinge joints 24 only allow pivoting movement in the direction of arrow AA in FIG. 5, and not in the direction of arrow BB. When in the unrolled position as shown, the slats 26 consequently remain generally flat and resist upward movement.

Referring to FIGS. 4, 4A and 5, the slats cannot be linearly pulled apart as the inner surface 65 of the hook 66 bears against the outer surface of the inner hinge element 38, and the lip 40 rests on the top surface of the hook 66. Similarly, the slats cannot be compressed together because the lip end 44 presses against the upper surface 75 of the hook 66. The engagement of the slats consequently has two spaced apart sets of engagement surfaces (61/63 and 69/75) that prevent downward rolling movement (in the direction BB in FIG. 5), a set of tension engagement surfaces 65/67, and a set of compression engagement surfaces 73/75.

As shown in FIGS. 5 and 6, the hinge joints 24 allow movement in the direction of arrow AA, up to a selected angle determined by the relative positions of the stop 64 on the hook 66, and the end 42 of the lip 40. In the specific design shown, the slats may be designed to allow up to about 75, 85, 95, 105 or more degrees of movement between adjacent slats. Allowing a larger angular range of movement between adjacent slats allows the cover 20 to fold as well as to roll up. Movement of the lip 40 into contact with the stop 64 prevents further movement. As a result, the cover rolls up, without adjacent slats folding over onto each other.

As shown in FIGS. 4, 5 and 6, when unrolled, the slats 26 may form a generally flat and rigid hard plate-like cover structure. As shown in FIGS. 4-5, when the cover is unrolled, the contact between the flat leg 44 against the ledge 60, and the contact between the stop 64 and the bottom surface of the web 30, resists upward bowing or bending between adjacent slats 26. The cover 20 is consequently highly resistant to forced entry.

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If the cover is designed with slats 26, the cover 20 will freely roll up as shown in FIG. 2, but will resist downward rolling due the engaging surfaces of the slats, as described above. However, a bi-directional cover may be made with slats without the engaging surfaces. In this case, the bi-directional cover 20 can either roll up or roll down. If the bi-directional cover is used with the side rails 180, the side rails alone may allow the bi-directional cover to roll up but prevent the bi-directional cover from rolling down. Accordingly, the cover assembly 15 as described here may use either a roll up cover as shown in FIGS. 3-6, or a bi-directional cover having slats forming hinge joints 24 that allow adjacent slats to pivot up or down.

The flexible material 34 may bow or crease into the groove 36 as the cover is rolled up. As shown in FIG. 6, when partially or fully rolled up, the ledge 60 of one slat 26 may extend partially into the groove 36 of an adjacent slat.

FIGS. 7-10 show an end fitting 150 for use in the cover assembly 15. The end fitting 150 has a tab and a T-slot 154. With FIG. 7 showing the end fitting 150 inverted for purpose of illustration, the end fitting 150 has a foot 156 having a foot groove or slot formed between a foot floor 160 and a foot top surface 162 at an acute angle to the foot floor 160. The foot floor 160 may be flat and horizontal, and parallel to the top surface of the arms forming the T-slot. The foot top surface 162 may form an angle of 20 to 60 or 30 to 45 degrees to the foot floor.

FIGS. 1-13 show one side of the cover assembly 15. The opposite side may be a mirror image of the side shown. The seal strip 84 shown in FIGS. 1 and 11 is omitted from FIG. 21 for purpose of illustration. Referring to FIGS. 11-13, each side rail assembly 148 of the cover assembly 15 has a side rail 180 having a top plate 184 attached to a clamp plate 182. Grip ridges 190 may be provided on the inner surface of the clamp plate. The top plate 184 may be perpendicular to clamp plate 182. The top plate has an outer section 186 that rests on the box rail 14 of the box 12 of pick-up truck 10, optionally with a resilient strip 172 between them, as shown in FIG. 11. The side rail 180 also has an arc section 192 attached to an inner section 188 of the top plate 184. The arc section 192 extends in a circular arc from the inner section 188 of the top plate to a vertical segment 194. The vertical segment 194 may be straight with the arc section 192 and the vertical segment 194 having a G-shape.

A latch plate 196 may be attached on top of the vertical segment, typically perpendicular to the vertical segment 194. A cup section 202 is attached to the latch plate 196, with the cup section having a center of curvature co-linear with the center of curvature of the arc section. A fitting arm 200 is attached to the cup section 202 and may be parallel to and overlie the latch plate 196. The inner edge of the fitting arm 200 may have a radius 204, to allow latches on the cover to more easily pass by the fitting arm 200 and extend into a latch slot 198 between the fitting arm 200 and the latch plate 196. A resilient seal strip 206 may be adhered to or otherwise provided on the top surface of the fitting arm 200, as shown in FIG. 11. In some designs, the latch plate 196 and the latch slot 198 may be omitted.

A roll rod 210 is pivotally contained within the arc section 192 of the side rail 180. As shown in FIGS. 12 and 13, the roll rod 210 has an arcuate hook 212 attached to a counter weight section 214. An inner cylinder 216 is attached to the counter weight section on an arm 218. The inner cylinder 216 fits inside of and pivots or rotates within the cup section 202. The outer surface of the roll rod has a radius nominally less (0.001 to 0.025 inch) than the radius of the inner wall of the arc section 192. Projections 226 may be formed in the

outer surface of the roll rod **210** to form spaced apart bearing surfaces. In this design, only the bearing surfaces **224** contact the inner wall of the arc section **192**, to allow the roll rod **210** to rotate more smoothly. The side rail **180** and/or the roll rod **210** may also be powder coated, or provided with other similar coatings, to reduce friction between them.

A drive plate **230** is attached to the back end of the roll rod **210**, typically adjacent to the tailgate of the pick-up truck. A pin **234** on the drive plate **230** may be pressed or positioned in a hole or slot **220** in the counter weight section **214**. Another bolt, pin or spline at the center of the drive plate **230** may be used to attach the drive plate to the roll rod **210**. The drive plate **230** on the left side rail assembly **146** shown in FIG. **13** is a mirror image of the drive plate **230** on the right side rail assembly **146** shown in FIG. **15**.

FIG. **13** shows the side rail assembly **148** in the open position, where the drive plate **230** extends upwardly and inwardly at an angle of about 45 degrees, and with an inner end of the drive plate **230** projecting above the fitting arm **200**. In the open position, the hook **212** is withdrawn into the arc section **192**. This allows the end fittings **150** of the cover move down onto the fitting arm **200**, as the cover **20** is unrolled. Similarly, the end fittings can be freely lifted and rolled up and off of the fitting arm **200** as the cover is rolled up. The weight of the counter weight section may automatically hold the roll rod **210** into the open position shown in FIG. **13**.

As the cover is unrolled, the roll rod **210** remains in the open position until the last slat at the back end of the cover moves down onto the inner end **240** of the drive plate **230**. As this occurs, the downward closing force of the slat rotates the drive plate **230** and the roll rod from the open position shown in FIG. **13**, through the intermediate position shown in FIG. **12**, into the closed or locked position shown in FIG. **11**. As the roll rod **210** moves into the closed position, the hook **212**, which extends over the entire length of the roll rod **210**, rotates inwardly and downwardly into the foot slot **158** of each of the end fittings **150** on the cover.

Movement of the hook **212** into the foot slot **158** of each of the end fittings, on both sides of the cover, securely locks the cover down onto the side rail. The hook **212** may optionally contact and press down on the foot **156** of each fitting, to clamp each fitting onto the fitting plate **200** of the side rail **180**. This can help to prevent any rattling or shaking of the cover while driving. It can also help to hold the edge seals down tightly against the box rails. With the hook positively pressing down on the foot **156** of each fitting, even slight upward movement of the cover off of the rails is prevented. This helps to discourage attempts to forcibly break into the box **12** via prying.

Each side of the last slat **27** (i.e., the slat at the back end of the cover adjacent to the tailgate **16**) may have a latch **191** mounted on a spacer **195** with a plunger **195** movable into the latch slot **198**, or into a position under the fitting arm **200**, if no latch slot **198** is used, for example as shown in FIG. **5** and as described in U.S. Pat. No. 7,537,264. The last slat **27** may alternatively have a keyed lock that engages with the tailgate, to prevent the cover from being opened or rolled up, even partially, without unlocking the last slat, and/or the tailgate.

Referring to FIG. **13**, optionally, a tether or a linkage **250** may be attached to one or both of the drive plates **230**, to secure the roll rods **210** into an open or a closed position. For certain uses, it may be advantageous to roll the cover up only part way. In this case, the tether or linkage can be used to

move the roll rod **210** into the closed or locked position, even though the last slat of the cover is not pressing down on the drive plate **230**.

The side rail **180** and the roll rod **210** may be aluminum extrusions. In this case, their various sections and components are integrally formed as single units. As described here, a section or component attached to another section of component means that it may be conventionally attached or integrally formed.

Referring to FIG. **15**, the last few inches of the hook **212** at the back end of the roll rod may optionally be removed leaving a gap **218**, to allow several slats to lift off of the side rails together. In this case, the cover may be opened and closed without necessarily using a pure rolling movement at the back end of the cover.

Referring to FIGS. **2A**, **3** and **15**, the cover **20** may be partially rolled up and locked in position, for example as shown in FIG. **2A**, via the same sequence described above. With the cover **20** partially rolled up as in FIG. **2A**, inward movement of the hook **212** will engage the foot slot **158** of the end fittings **150** on the slats **26** in the front section of the cover **20**. Accordingly, the cover **20** may be locked into various intermediate positions between fully unrolled and closed, and fully rolled up and open.

The back or last slat **27** cannot depress the drive plates **230** to operate the roll rods **210** when the cover **20** is in a partially rolled up position. Accordingly, the tether or linkage **250** may be used to manually rotate and hold the roll rods **210** inwardly. The tether may be formed via an elastic cord and a hook for engaging a fitting at the back end of the box **12**. The linkage may be a bar or lever similarly positioned, for moving the roll rods **210** into the locked position without the need for the last slat **27** to actuate the drive plates **230**.

Although FIGS. **11-13** show a roll rod **210** used to lock the cover **20** onto the side rails **180**, other mechanisms may alternatively be used. For example, mechanisms that linearly move an element into the foot slots **158** horizontally from the side, or on an angle from above the foot slots **158** may be used. FIG. **11A** shows an alternative design with a hook **212** or similar element engaging into a fitting **150** on an inboard bottom surface of the cover, rather than at the sides of the cover as shown in FIG. **11**.

The cover **20** may optionally use slats such as slat **26A** shown in FIG. **16** which is the same as the slat **26**, but includes a slot extension **55** which may be provided to reduce pinch points.

FIG. **17** shows an alternative cover **21** using a different end fitting **70** along with the resilient seal strips **84**. In FIG. **17**, a tab **72** of each end fitting is pushed or positioned into a slot **52** and is held in place with fasteners or adhesive. A T-section of the seal strip **84** is slid or threaded through a slot **76** in each end fitting **70**, at both ends of the slats **26**. This may be done before or after the end fittings are attached to the slats **26**. The length of the body **74** of the end fittings may be less than the width of the slats **26**. This leaves a free segment of the seal strip between each adjacent end fitting **70**. Consequently, the free segment of the seal strip **84** can freely flex and bend as the cover is rolled and unrolled.

As shown in FIGS. **18** and **19** the T-slot **76** is located between arms **78** on the body **74** of the end fitting **70**. The arms **78** have flat top surfaces **80**. Turning to FIGS. **20** and **21**, the seal strip **84** has an outer arm **88** and an inner arm **90** joined to a T-section **86**. The inner arm **90** may include a seal lip **92**. The seal strip **84** is a resilient material, such as rubber. This attachment of the end fittings to the slats **26**, and

this attachment of the seal strip to the end fittings, may also be used with the end fittings **150** in the cover **15** described above.

With the cover **21**, the end fittings **70** rest on top of a side rail and the individual end fittings **70** are not engaged or locked down. Rather, the cover **21** is attached to the front ends of the rails, e.g., via fasteners, and the back end of the cover is latched or locked down via latches **195** shown in FIG. **6** or similar devices. Consequently, simple side rails, such as the side rail **302** shown in FIG. **27** may be used.

FIGS. **22-26** show another alternative cover assembly **100**. This design uses an end fitting **70A** having a tab **72A** extending at right angles from a body **74A**. A T-slot **76A** is formed between inverted L-shaped arms **78A** on the body, with the arms **78A** having flat top surfaces **80A**. The fitting **70A** has a foot **82** on the bottom of the body **74A**, with a foot slot **83** in the foot. Only the foot **82** and foot slot **83** at one end of the fitting **70A** is used. However, if the fitting may be symmetrical front-to-back, so that the same fitting may be used on both sides of the cover, instead of having separate and different left and right side fittings.

As shown in FIG. **26**, the fitting **70A** is attached at the opposite ends of each slat **26** of the cover and the seal strip **84** attached as described above relative to FIG. **17**. FIG. **22** shows a side rail **102** generally having a T-section **110** and an end fitting channel section **112**. The T-section includes a top plate or surface **104** and a clamp plate **106** extending down to the top plate **104**. Ridges **108** or other gripping surface elements may be provided on the inside surface of the clamp plate **106**. The end fitting channel section **112** generally includes channel sidewalls **114** joining channel floors **116** on opposite sides of a drain slot **118** leading down to a drain channel **124**.

The channel sidewalls **114** may be parallel to the clamp plate **106**. The channel floors **116** may be parallel to the top plate **104**. The top plate **104** may be perpendicular to the clamp plate **106** and/or the channel floors **116**. The drain channel **124** may be flat with angled sides, as shown, or it may be tubular, square, or of other geometric or irregular shape. The bottom surface of the drain channel **124** is preferably continuous to allow the drain channel **124** to carry water without leaking.

Referring still to FIG. **22**, a curve or ramp surface **130** on the channel sidewalls may extend down and end at a retainer lip **132**. As shown in FIG. **23**, a hook strip **140** has upwardly projecting equally spaced apart hooks **142**. The hooks **142** are spaced apart by the same dimension as the spacing between adjacent end fittings **70A**. The hook strip **140** is sized and shaped to fit into or onto the end fitting channel section **112**. In the design shown, the hook strip **140** is designed to slide into channel section **112** from one end, with the retainer lips **132** holding the hook strip **140** in the channel section **112**. Alternatively, the ramp section **130** and/or the retainer lips **132** may be omitted and the hook strip may be attached onto the side rail **102** via adhesives, welding, fasteners, etc.

As shown in FIG. **23**, the hook strip **140** may have openings **146**, to allow water in channel section **114** to move through the hook strip **140** and into the drain slot **118** and the drain channel **124**. Alternatively, other drain passages may be provided via grooves, slots, protuberances, etc. on the channel floors **116** and/or the bottom or sides of the hook strip **140**. Typically, the number of hooks **142** matches the number of slats **26**.

Referring to FIGS. **22-26**, the openings or raised ends of the hooks **142** are facing the back of the truck. The forward-most slat **23** of the cover **20** is attached to the side rails **102**,

typically via a fastener or stud on the slat **23** extending through an extension plate on the slat **23**, or optionally through the top plate **104** between the clamp plate **106** and the outer channel sidewall **114**. The cover **20** may be rolled up to provide access to the box of the truck. One or more tethers or clips may be used to hold the cover in the rolled up position, while driving the truck, if desired.

To cover the box, the cover **20** is unrolled. As this occurs, the end fittings **70A** on the left and right ends of the slats **28** sequentially move into the channel section **112**. The foot **82** of each end fitting **70A** moves under a hook **142**, with the back end of the hook **142** moving into the foot slot **83**.

With the cover **20** unrolled, the box is covered and secure, and may not be accessed without opening the tailgate, as shown in FIG. **1**. The lock on the tailgate **16** may therefore be used to lock the box as well. With the cover unrolled, the slats **26** may not be lifted up off of the side rails **22** because of the engagement of the hooks **142** into the foot slots **83** of the end fittings **70A**. Consequently, the cover is firmly secured at the sides to better resist prying and/or impacts intended to breach the cover **20**.

The hooks **142** may be replaced by lateral pins, loops or bars, since the cover **20** using the end fittings **70A** only requires equally spaced apart fixed rail elements on or in the side rails to engage with a corresponding element on the cover, when the cover is unrolled. While the drawings show hooks **142** on a separate hook strip **140**, the strip **140** may be omitted and the hooks **142** or similar element provided directly in or on the side rail **26**. For example, in place of hooks **142** on a hook strip **140**, lateral tabs or projections may be formed on the side rails, with the end fittings attaching around or onto the tabs in a rolling engagement.

It is also possible to reverse the position of the foot slots and the hooks, by placing a hook or other projection on the end fitting, and providing slots or recesses in the side rail adapted to be engaged by the projections on the end fittings. It is also possible to use inter-engaging or inter-fitting projections on both the end fittings and on the side rails.

Since the end fittings move in an arc when engaging or disengaging from the hooks **142**, the foot slots **83** and/or the hooks **142** may optionally be curved to generally match the arc of movement. If used, the curvature of the slots **83** and or the hooks **142** may change progressively from front to back, to match the radius of curvature of the cover. Specifically, since the slats at the back of the cover move in a tighter radius than the slats at the front of the cover, the slots **83** and hooks **142** may have more curvature at the back than at the front.

It is also possible to provide the end fitting engagement element, such as the slot **83**, or a projecting engagement element on the end fitting, on one side of the end fitting, instead of on the bottom as shown in FIGS. **24-25**. For example, an engagement element may extend out and down from the outer side surface **85** shown in FIG. **24**. In this case, the engagement element may engage a counterpart engaging element on the side rail, but with the counterpart not in the channel section **112**. Specifically, the counterpart engaging element may be out of the channel section **112**, to the inside of the inner channel wall **114**, optionally attached to or supported by the inner channel wall **114** or the channel floor **116**.

FIGS. **27** and **28** show another design having a side rail **302** having a cover support ledge **316**, a top plate **104** and a clamp plate **106**, but without a drain channel. Using a continuous sheet of flexible material **34** on the slats **26** and a seal **318** as shown in FIG. **28** and as in U.S. Pat. No. 7,537,264, may provide sufficiently water tight sealing.

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Drain channels in the side rails may therefore be used or omitted. Eliminating the drain channel allows a simpler extrusion shape to be used for the side rails.

Although the covers **20** and **21** are described above as roll up covers, they can also fold up. As shown in FIG. **15**, the gap **218** allows several slats **26** be lifted up off of the side rails, typically after releasing the latch **195**. For example, if the gap **218** is 7 inches, and the slats are 1.6 inches wide, then four slats with a front to back length of 6.4 inches may be lifted together, with the four slats remaining in a flat plane. This group of four slats may then be folded over with the hinge joints **24** between the fourth, fifth and optionally sixth slats opening. A subsequent group of four (or more or fewer) slats may then also be folded over, with the folding continuing as desired. The folded cover takes on a generally oval shape, in contrast to the round shape taken when the cover is rolled up.

FIGS. **29** and **30** show a sliding cover clamp system **320** which may be used to attach a roll-up cover or a folding cover to side rails, without the need for any through holes in the cover. A slide housing **322** is attached to the bottom surface of a slat at the front of the cover, or to the bottom surface of a cab panel, using adhesives and/or blind fasteners that do not extend all of the way up through the cover. The slide housing **322** may be provided as a segment **324** of an extrusion. A slide plate **326** is slidable laterally in the slide housing **322**. A slide plate screw **328** can be tightened to lock the slide plate **326** in an in position or an out position, and temporarily loosened to allow movement of the slide plate **326** between the in and out positions.

Also as shown in FIGS. **29** and **30**, a rail clamp **332** is provided in the form of an extrusion segment **334** shaped to slide over the drain channel of the side rail. A rail clamp screw can be tightened to lock the rail clamp in place on the side rail, and loosened to allow the rail clamp **332** to slide on the side rail.

Referring still to FIGS. **29** and **30**, in use the cover is placed onto the side rails. With the front slat or cab panel positioned at the front end of the side rails, the slide plate **326** on both the left and right sides of the cover is slid outwardly. The outer end of slide plate **326** moves into a slot **340**, such as a latch slot, or other opening in the side rail. The clamp screw **328** is tightened to hold the slide plate in place. The slat or cab panel is consequently locked down vertically onto the side rails.

To prevent the cover from moving on the rails in the front to back direction, a rail clamp **332** slidably engaged on the side rail is slid forward until it contacts the slide plate. The rail clamp **332** is then locked in place using the rail clamp screw. The front end of the cover is then locked onto the rails against movement in any direction.

Thus, novel cover assemblies have been shown and described. Various changes and substitutions may be made without departing from the spirit and scope of the invention. The invention therefore should not be limited except by the following claims and their equivalents.

What is claimed is:

1. A cover assembly for a vehicle box, comprising:
a plurality of rigid rectangular elements, the plurality of elements being pivotally connected together and movable between a closed position wherein the plurality of elements are deployed for covering the vehicle box, and an open position wherein the plurality of elements are retracted to allow access to the vehicle box, at least one of the rigid rectangular elements includes a first fixed locking element provided on a first end fitting coupled to a first end of the at least one element and a

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second fixed locking element is provided on a second end fitting coupled to the second end of the at least one element opposite the first end;

first and second side rails attachable to the vehicle box, the first side rail including a first movable locking element movable between a first locked position in which the first movable locking element engages the first fixed locking element to secure the at least one of the rigid rectangular elements in the closed position to restrict movement of the at least one element away from the at least one side rail, and an unlocked position in which the movable locking element does not restrict movement of the at least one element, and the second side rail including a second movable locking element movable between a second locked position in which the second movable locking element engages the second fixed locking element to restrict movement of the at least one element in the closed position away from the second side rail, and an unlocked position in which the second movable locking element does not restrict movement of the at least one element.

2. The cover assembly for a vehicle box of claim **1**, wherein the first fixed locking element comprises a slot, and the first movable locking element comprises a rod received within the first side rail and having a rod hook, the rod being movable between the locked position wherein the rod hook projects into the slot to secure the at least one element in the closed position to the first side rail, and the unlocked position wherein the rod hook is withdrawn from the slot to allow the at least one element to be retracted toward the open position.

3. The cover assembly for a vehicle box of claim **2**, wherein the rod is a roll rod rotatable between the locked position and the unlocked position.

4. The cover assembly for a vehicle box of claim **3**, wherein the first side rail comprises an arc section receiving the roll rod.

5. The cover assembly for a vehicle box of claim **2**, wherein the first movable locking element further comprises a drive plate engageable by a second of the plurality of rectangular rigid elements to move the rod from the unlocked position to the locked position as the second element moves into the closed position.

6. The cover assembly for a vehicle box of claim **5**, wherein the rod is a roll rod and the roll rod is received within an arc section of the first side rail to be rotatable between the locked position and the unlocked position, and wherein the drive plate rotates the roll rod from the unlocked position to the locked position.

7. The cover assembly for a vehicle box of claim **6**, wherein the second element comprises an upper surface and a lower surface, and wherein the drive plate is engaged by the lower surface as the rear element moves into the closed position.

8. The cover assembly for a vehicle box of claim **1**, wherein the cover assembly is a roll-up cover designed to be retracted from the closed position to the open position by rolling the plurality of elements together.

9. The cover assembly for a vehicle box of claim **1**, wherein the at least one of the plurality of elements comprises a first end and includes an end fitting coupled to the first end, and wherein the end fitting defines a seal slot with a resilient seal received in seal slot and the resilient seal having arm extendable over the first side rail.

10. The cover assembly for a vehicle box of claim **1**, wherein a first element and second element of the plurality of rigid rectangular elements are pivotally connected

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together via a first hinge element on a first side of the first element and a second hinge element on a second side of the second element adjacent the first side of the first element to form a pivot joint between the first element and the second element.

11. The cover assembly for a vehicle box of claim 10, wherein the first hinge element comprises a curved hinge hook and the second hinge element comprises a curved hinge lip engaging the curved hinge hook.

12. The cover assembly for a vehicle box of claim 1, wherein the cover assembly includes a fabric cover overlying the plurality of rigid rectangular elements.

13. A cover assembly for a vehicle box having a forward end and a rear end, comprising:

a plurality of slats, the plurality of slats being pivotally connected together and movable between a closed position wherein the slats are deployed for covering the vehicle box, and an open position wherein the slats are retracted to allow access to the vehicle box;

at least two of the slats comprising a first end fitting having a first fixed locking element and a second end fitting having a second fixed locking element;

first and second side rails attachable to the vehicle box with a forward and rear end of each side rail respectively positionable adjacent the forward and rear ends of the vehicle box, each side rail including a movable locking element movable between a locked position in which the movable locking element is simultaneously engaged with adjacent fixed locking elements of the at least two slats to restrict movement of the at least two slats in the closed position away from each side rail, and an unlocked position in which the movable locking element is simultaneously disengaged from the adjacent fixed locking elements of the at least two slats allowing movement of the at least two slats relative to the side rails.

14. The cover assembly for a vehicle box of claim 13, wherein each movable locking element comprises a rod received within one of the side rails and having a rod hook, the rod being movable between the locked position wherein the rod hook projects into the adjacent fixed locking elements of the at least two slats, and the unlocked position wherein the rod hook is disengaged from the adjacent fixed locking elements of the at least two slats to allow the at least two slats to move relative to the side rails.

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15. The cover assembly for a vehicle box of claim 14, wherein the fixed locking elements comprise a slot into which the rod hook projects in the locked position.

16. The cover assembly for a vehicle box of claim 14, wherein each movable locking element further comprises a drive plate engageable by a rear one of the slats to move the rod from the unlocked position to the locked position as the plurality of slats move into the closed position.

17. The cover assembly for a vehicle box of claim 16, wherein each rod is a roll rod and each roll rod is received within an arc section of one of the side rails to be rotatable between the locked position and the unlocked position, and wherein the drive plate rotates the roll rod from the unlocked position to the locked position.

18. The cover assembly for a vehicle box of claim 16, wherein the rear slat has an upper surface and a lower surface, and wherein each drive plate is engaged by the lower surface as the rear slat moves into the closed position.

19. The cover assembly for a vehicle box of claim 16, wherein the at least two slats having the fixed locking elements that are engaged and disengaged by the movable locking elements are not the rear slat.

20. The cover assembly for a vehicle box of claim 13, wherein the cover assembly is a roll-up cover designed to be retracted from the closed position to the open position by rolling the plurality of slats together from a rear one of the plurality of slats toward the forward end of the side rails.

21. The cover assembly for a vehicle box of claim 13, wherein each end fitting defines a seal slot with a resilient seal received in seal slot and the resilient seal having arm extending over an adjacent one of the side rails.

22. The cover assembly for a vehicle box of claim 13, wherein a first slat and second slat of the plurality of slats are pivotally connected together via a first hinge element on a first side of the first slat and a second hinge element on a second side of the second slat adjacent the first side of the first slat to form a pivot joint between the first slat and the second slat.

23. The cover assembly for a vehicle box of claim 22, wherein the first hinge element comprises a curved hinge hook and the second hinge element comprises a curved hinge lip engaging the curved hinge hook.

24. The cover assembly for a vehicle box of claim 13, wherein the cover assembly includes a fabric cover overlying the plurality of slats.

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